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VOL. CXXXVIII.—No. 3590] LONDON: FRIDAY EVENING, OCTOBER 17, 1924 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES :—

TESTING MOTOR ALTERNATOR SET (22.5 K.V.A. and 10 K.V.A. Three phase Alternators), complete with Controlling Switchgear, Portable Transformers, &c.

Tenders due on the 4th November, 1924.

Tender forms obtainable from above. 7248

Civil Engineer Required by the GOVERNMENT of NIGERIA for service as an Assistant Engineer in the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 months' nor more than 18 months' service with possible extension. Salary £729, rising to £920 a year by annual increments of £40. Free quarters and passages and liberal leave on full salary. Candidates, aged 30-35, must be fully qualified Civil Engineers, holding A.M.I.C.E. or equivalent professional qualifications, and have had considerable experience (preferably in charge) on large engineering or municipal works. Preference given to candidates with experience on waterworks construction.—Apply at once, by letter, stating age, qualifications, and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W.1, quoting reference M/13154. 7228

Draughtsman Required for the Tanganyika Government Railway for a tour of 20 to 30 months' service, with possible extension. Salary £300, rising to £400 a year by annual increments of £15, payable in the Tanganyika Territory in local currency, plus a temporary local allowance of 20 per cent. authorised up to the 31st December, 1924, when it will be subject to review. Outfit allowance of £30 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, preferably unmarried, aged 25 to 40, should have had general experience as a Draughtsman on a railway or in Railway Contractor's shops, especially on carriage and wagon work.—Apply at once by letter, stating age, whether married or single, and giving particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W.1, quoting clearly at head of application M/13160. 7193

Section Engineers Required for the CONSTRUCTION BRANCH of the FEDERATED MALAY STATES RAILWAYS for four years' service with possible extension. Salary 400 dollars a month, rising to 475 dollars a month by annual increments of 25 dollars a month, plus a temporary non-pensionable allowance of 10 per cent., which is liable to cancellation or revision, plus a commuted Field Allowance of 50 dollars a month. The exchange value of the dollar, in sterling, is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is at present considerably less than that of 2s. 4d. in the United Kingdom. Free passage provided. On expiration of agreement a bonus of six months' salary may be allowed provided the work and conduct of the person engaged has been in every way satisfactory. Candidates, age 30 to 38 and unmarried, must be fully qualified Railway Engineers who have received good training and experience on recognised European, American, or Colonial Railways. Members or Associate Members of the Institution of Civil Engineers preferred.—Apply at once by letter, stating age, whether married or single, and particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W.1, quoting at top of application M/12707. 7237

Newcastle-upon-Tyne Education COMMITTEE.

RUTHERFORD TECHNICAL COLLEGE.

Principal: C. L. ECLAIR-HEATH, Wh.Sc., A.M.I.M.E.

REQUIRED, for JANUARY NEXT, LECTURER in ELECTRICAL ENGINEERING for senior work. Candidates should have had good drawing-office and works experience, have received a good technical education in a University or Technical College, and have obtained a University Degree or its equivalent. Teaching experience desirable.

Salary according to Burnham Technical Scale, less 5 per cent.

Applications (on forms to be obtained by sending stamped addressed foolscap envelope) to be returned to the undersigned not later than first post Tuesday, 11th November, 1924.

THOS. WALLING,
Director of Education.

Education Office, Northumberland-road. 7225

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for :—

4243 TONS STEEL FLAT-BOTTOM RAILS, 90 lb. Per Yard.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, E.C.2, on or after 10th October, 1924.

A fee of Twenty Shillings will be charged for the specification, which is not returnable.

Tenders must be submitted not later than Noon on Saturday, 18th October, 1924.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By order of the Board,
R. C. VOLKERS,
Secretary.

7209

County Borough of Eastbourne.

BOROUGH ENGINEER AND SURVEYOR'S DEPARTMENT.

TENDERS are INVITED for the EXCAVATION of MUD and BEACH, amounting to approximately 13,700 cubic yards, to form the proposed Lake in Gilbert Recreation Ground. The work will probably be most efficiently executed by the Grab or Scoop method.

Plans and general conditions may be seen and specification and form of Tender obtained, at the Borough Engineer's Office, Town Hall, on payment of One Guinea.

Sealed Tenders, endorsed "Gilbert Recreation Ground Lake," to be delivered at the Borough Engineer's Office not later than the 21st October, 1924.

The Corporation does not bind itself to accept the lowest or any Tender.

LESLIE ROSEVEARE, M.Inst.C.E.,
Borough Engineer.

The Town Hall,
Eastbourne.
October 1924 7202

The Engineer

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A Double Helical Gear Generator.

Failure of Intensified Research Work.

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Locomotive Coaling Installation at Nine Elms.

100 Years of British Railways—No. XVI.

PUBLIC NOTICES

Epsom Urban District Council.

WATERWORKS.

NEW BORING.

The Epsom Urban District Council are prepared to receive TENDERS for the SINKING of a BORING with Lining Tubes 30in. in diameter at the Waterworks, East-street, Epsom.

Contractors, who must be on the King's Roll, desirous of tendering may obtain copies of the specification, general conditions, and form of Tender from the office of Mr. W. Vaux Graham, M. Inst. C.E., 5, Queen Anne's Gate, Westminster, S.W.1, on payment of the sum of Two Guineas, which will be returned on receipt of a bona fide Tender.

Tenders, endorsed "Tender for New Boring," must be sealed and addressed to the Clerk of the Council, 37, Church-street, Epsom, so as to reach him not later than first post on Monday, October 27th, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

E. G. WILSON,
Clerk.

37, Church-street,
Epsom. 7203

Epsom Urban District Council.

WATERWORKS.

ADDITIONAL PUMPING PLANT.

The Epsom Urban District Council are prepared to receive TENDERS for the PROVISION, ERECTION, and SETTING to WORK of a complete PUMPING PLANT of British manufacture, consisting of a Centrifugal Bore-hole Pump and a High-lift Pump actuated by an Internal Combustion Engine with all the necessary accessories and spare parts.

Contractors, who must be on the King's Roll, desirous of tendering may obtain a copy of the specification, general conditions, and form of Tender from the office of Mr. W. Vaux Graham, M. Inst. C.E., 5, Queen Anne's-gate, Westminster, S.W. 1, on payment of Five Pounds, which will be returned on receipt of a bona fide Tender.

Tenders, endorsed "Tender for Additional Pumping Plant," must be sealed and addressed to the Clerk of the Council, 37, Church-street, Epsom, so as to reach him not later than first post on Monday, November 24th, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

E. G. WILSON,
Clerk.

37, Church-street, Epsom. 7240

Rochester and Chatham Joint SEWERAGE BOARD.

OUTFALL SEWER.

CONTRACT No. 1.

The Board is prepared to receive TENDERS for the CONSTRUCTION of about 6390 Yards Lineal of CONCRETE SEWER CULVERT, size 5ft. high by 3ft. 6in. wide, the whole length being in tunnel, together with deep manholes and other appurtenant works.

Plans may be seen and quantities and form of Tender obtained at the office of the Engineers, Messrs. W. H. Radford and Son, Chartered Civil Engineers, Albion Chambers, King-street, Nottingham (and also at my office as under, from Ten to One each day of the week commencing November 3rd, when Messrs. Radford's assistant will be in attendance), on deposit of Five Guineas (cheque), which will be returned on receipt of a bona fide Tender and the return of the quantities.

The lowest or any Tender will not necessarily be accepted.

Sealed Tenders to be delivered to me at my office as under, on or before Tuesday, November 18th, endorsed "Tunnel Sewer."

By order,
EDWARD B. LEE,
Clerk to the Board.

Town Hall, Chatham,
13th October, 1924. 7227

PUBLIC NOTICES

Siam State Railways.

NOTICE.

TENDERS are INVITED for the SUPPLY of 240 Pairs of CARRIAGE AND WAGON BUFFERS with SIDE-CHAINS.

Specifications and drawings may be obtained against payment of £1 from Messrs. C. P. Sandberg, 40, Grosvenor-gardens, London, S.W.1.

Sealed Tenders, with the inscription "Tender for the Supply of Carriage and Wagon Buffers with Side-chains, R.E. 3467," must be forwarded to the undersigned, at whose office in Bangkok, Siam, they will be received up to Fourteen o'clock on the 15th January, 1925, at which place and hour the Tenders will be publicly opened and read.

Right is reserved to reject any or all Tenders and to accept any Tender which in the opinion of the undersigned is to the best interest of the Siam State Railways.

Department of State Railways,
Bangkok.
(Sgd.) ACTING COMMISSIONER-GENERAL.
7211

The Fylde Water Board.

HODDER SCHEME.—STOCKS RESERVOIR.

CAST IRON TUNNEL SECTIONS OR TUBBING.

The Fylde Water Board invite TENDERS from Ironfounders for CAST IRON SEGMENTS for lining about 710ft. of 18ft. diameter tunnel.

The approximate weight will be 1070 tons for straight sections, and 190 tons for curved sections.

Specification, drawings, and all particulars may be obtained from the undersigned.

Tenders must be received by the undersigned on or before Wednesday, November 5th, 1924.

The lowest or any Tender not necessarily accepted.

GEO. F. ATKINSON,
Engineer.

Sefton-street,
Blackpool.
October 10th, 1924. 7197

The Municipality of Singapore.

TENDERS FOR STEEL PIPES, VALVES, &c.

Sealed TENDERS, addressed to Messrs. C. C. Lindsay and Peirce, 180, Hope-street, Glasgow (Agents to the Municipality of Singapore), endorsed "Singapore Municipality—Tender for Steel Pipes, Valves, &c.," will be received until 5 p.m. on Friday, the 31st October, 1924, for the SUPPLY and DELIVERY at Singapore of about SIX MILES of WELDED STEEL PIPE, 32in. internal diameter; about SIX MILES of WELDED STEEL PIPE, 34in. internal diameter; about SIX MILES of WELDED STEEL PIPE, 36in. internal diameter; together with certain CAST IRON PIPES, VALVES and SPECIALS. Though lap-welded steel pipes are specified, tenderers are at liberty to offer other makes of steel pipes, but riveted pipes will not be accepted, and whatever make of pipe may be offered must be of British material and manufacture. Forms of Tender and specification may be obtained on and after the 10th October, 1924, from Sir Alex. Binnie, Son and Deacon, 30, Buckingham-gate, Westminster, S.W. 1, or from the Agents to the Municipality, on receipt by either of them of a cheque to the value of £5 made out to the Agents, Messrs. C. C. Lindsay and Peirce, which amount will be returned on receipt of a bona fide Tender. Drawings may be seen at the offices of Messrs. Sir Alex. Binnie, Son and Deacon. The lowest or any Tender will not necessarily be accepted, nor will any expenses in connection with tendering be defrayed. No Tenders will be considered except from actual manufacturers capable of supplying the pipes at the rate of 90 of each size per fortnight, together with a proportionate number of specials.

C. C. LINDSAY and PEIRCE,
180, Hope street, Glasgow.
Agents to the Municipal Commissioners of Singapore. 7157

PUBLIC NOTICES

TENDERS FOR THE CONSTRUCTION OF HOPPER BARGES.

The Poole Harbour Commissioners are prepared to consider TENDERS for CONSTRUCTION of TWO DUMB HOPPER BARGES of about 350 tons capacity, to be built of steel.

Tenderers to submit their own specification and to state date of delivery and price at Poole.

Tenders and full specification to be forwarded to the undersigned not later than Tuesday, the 28th. inst.

R. M. MANSER,
Clerk to the Harbour Commissioners.
7206 Poole, Dorset.

City and County of Norwich.

APPOINTMENT OF CITY ENGINEER, ARCHITECT AND SURVEYOR.

APPLICATIONS are INVITED for the POSITION of CITY ENGINEER, ARCHITECT and SURVEYOR to the Norwich Council.

The commencing salary will be £800 per annum (plus the appropriate Civil Service bonus). Means of locomotion will be provided or a reasonable sum allowed.

Preference will be given to applicants who are under the age of 45 and who are Corporate Members of the Institution of Civil Engineers.

Terms and conditions of appointment and form of application can be obtained from the undersigned.

Applications, endorsed "City Engineer, &c.," together with copies of not less than three recent testimonials, to be sent to the undersigned not later than the 12th November, 1924.

Canvassing will disqualify.

ARNOLD H. MILLER,
Town Clerk.

Guildhall, Norwich,
October, 1924. 7219

SITUATIONS OPEN

WANTED for India, SALES ENGINEER, with knowledge of Modern Boiler house Plants, with Workshop and Drawing office Training and with experience in Superheater, Mechanical Draught, Mechanical Stokers. Position would suit Boiler Insurance Co.'s Inspector.—Address, giving particulars of experience, references and salary required, 7190, The Engineer Office. 7190 A

WANTED, FOUNDRY MANAGER, with Experience in General Iron and Non-ferrous Work by modern methods. Initiative and organising ability essential. London district.—Address fullest details, 7241, The Engineer Office. 7241 A

AIRCRAFT CHIEF INSPECTOR REQUIRED. Must be capable organiser and possess full technical qualifications and thorough knowledge of latest Aircraft Inspection requirements; those possessing the qualification of a Ground Engineer preferred.—Address, fully stating age, salary required, previous experience, when free, &c., 7198, The Engineer Office. 7198 A

ELECTRIC CRANE EXPERT for Estimates and Technical Correspondence. Age 30/40. Give full particulars and salary in confidence.—Address, 7221, The Engineer Office. 7221 A

INDIA.—STRUCTURAL ENGINEER, with Thorough workshops and drawing-office training, experienced in the preparation of stress diagrams, calculations, designs, estimates and manufacture of Bridge and Structural Steel Work, REQUIRED to fill a senior position with a well-established British firm who have engineering works in India. Age 35 to 40.—Only those with suitable qualifications need apply to Z.D. 674, c/o Deacon's Advertisement Agency, Leadenhall-street, E.C. 3. 7170 A

MANAGER WANTED for Ship-repairing and General Engineering Works. Must be thoroughly practical, good organiser and able to control men. Commercial experience an advantage.—Address, in confidence, giving full details of experience, qualifications, and salary required, P9684, The Engineer Office. P9684 A

WORKS MANAGER REQUIRED for General Engineering Works and Foundry, 300 hands.—Address, stating experience, age, salary required, P9687, The Engineer Office. P9687 A

AN Experienced RAILWAY CARRIAGE and WAGON DRAUGHTSMAN, accustomed to Preparation of Designs for tendering purposes for home and export; expert Checker and able to Take Charge of Contracts. A JUNIOR RAILWAY CARRIAGE and WAGON DRAUGHTSMAN is ALSO REQUIRED. Applications treated with strict confidence.—Address, 7201, The Engineer Office. 7201 A

CONSTRUCTIONAL DRAUGHTSMAN. Good Detailer for Shop Drawings; London Engineer's office. State experience and salary required.—Address, P9682, The Engineer Office. P9682 A

DRAUGHTSMAN Accustomed to Designing Small Automatic Single-purpose Machines, as used in Clock Manufacture; only first-class men need apply. State age, experience, salary.—Address, P9675, The Engineer Office. P9675 A

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SITUATIONS OPEN (continued)

DRAUGHTSMAN, Experienced in Laundry Machinery must be capable of Designing. Vacancy in a progressive firm.—Address, stating experience and salary required, 7200, The Engineer Office. 7200 A

DRAUGHTSMAN (JIG and TOOL) REQUIRED IMMEDIATELY; varied class of work; only those with up-to-date Tool-room Experience need apply, stating age, experience and salary required, to W. O., c.o. Baker Perkins Ltd., Westwood Works, Peterborough. 7208 A

DRAUGHTSMAN, LONDON DISTRICT.—DRAUGHTSMAN REQUIRED, with Shop Experience, knowledge of Jigs and Tools and able to Design Machines under supervision; must be quick. Permanent position likely for suitable man.—Address, giving age, particulars of experience and salary required, 7213, The Engineer Office. 7212 A

DRAUGHTSMAN REQUIRED, Thoroughly Experienced in design of Electric and Steam Winders and Haulages. Permanency for suitable man.—Address, stating age and wages, &c., 7240, The Engineer Office. 7240 A

DRAUGHTSMAN WANTED, Experienced with Elevators, Constructional Work, Crushing and Grinding Machinery, &c.—Address, stating age, whether married or single, wages required and full particulars of experience, 7216, The Engineer Office. 7216 A

DRAUGHTSMAN WANTED, Thoroughly Experienced in the Design of Bridge and other Structural Steelwork, preferably having experience in both Shop and Railway Engineer's Office Work.—Applications, stating age, salary required, full particulars of training and experience, and when at liberty to be addressed to the JOINT CHIEF ENGINEERS, Great Western Railway, Paddington Station, W. 2. 7199 A

SENIOR DRAUGHTSMAN REQUIRED, Accustomed to taking charge of large contracts; must also be an experienced designer; permanency for good man.—Apply, stating age and salary requred, to CHIEF DRAUGHTSMAN, Redpath, Brown and Co., Ltd., Trafford Park, Manchester. 7245 A

SEVERAL GOOD SENIOR and JUNIOR DRAUGHTSMEN REQUIRED for Aeronautical Work by S. E. SAUNDERS, Ltd., East Cowes, Isle of Wight. Give particulars of experience and salary. 7195 A

STRUCTURAL DRAUGHTSMAN.—CAPABLE MAN REQUIRED for the East; experienced in Bridge and Light Structural Work; well up in Theory. Good opportunity for first class man.—Write, giving details of experience, and copies of testimonials, to Z.Z. 693, c.o. Deacon's Advertisement Agency, Leadenhall-street, London, E.C. 7191 A

CONSTRUCTIONAL IRONWORK.—FOREMAN for Small Works in Midlands WANTED, who has had exactly similar experience; must be in position to give accurate prices for all classes of manufactures.—Address, 7217, The Engineer Office. 7217 A

FOREMAN REQUIRED in Experimental Dept. for the development of Aeroplane Engines. Must have been previously employed on similar class of work and qualified to supervise the building of new designs.—Address, stating age, experience, and salary required, to 7224, The Engineer Office. 7224 A

SITUATIONS WANTED

A M.I.C.E., 33, Railway Locomotive Works and D.O. trained, experience I.C. engines and general engineering, used to control of large staffs, wide technical knowledge, commercial experience, Disengaged, DESIRES POST where initiative and varied experience are needed.—Address, P9677, The Engineer Office. P9677 B

ENGINEER DESIRES RE-ENGAGEMENT. Production engineer, machine shop super., tool super., Rapid production small to medium work. Sound organising ability, practical man, good education, 16 years' exp. Age 35; ex. refs.—Address, P9658, The Engineer Office. P9658 B

ENGINEER (Production or Sales) 30 Years of Age, Anglo-American experience, DESIRES CHANGE with growing British firm. Real live man of ripe experience. Steam, oil, gas and petrol engines. Expert organiser.—Address, P9685, The Engineer Office. P9685 B

MECH. ENGINEER, Scotsman (27), Holding Diploma and Associateship of Royal Tech. Coll., Glasgow, SEEKS NEW APPOINTMENT in New Zealand, Australia, or South Africa, as Manager, Assistant Manager, or in a responsible position, where good knowledge of business organisation, energy, tact and ability is required. At present manager of large department doing specialised work. Apprenticeship served with well-known engineering firm and outside erecting work done.—Address, P9671, The Engineer Office. P9671 B

MECHANICAL ENGINEER, 21 Years' Workshop experience, first-class draughtsman, B.Sc. (Eng.), public school education, able to handle men, READY to TAKE UP a SITUATION at once.—Address, P9680, The Engineer Office. P9680 B

MECH. ENGINEER (24), Public School, Sound training, shops, D.O., estimating; 3 yrs. as draughtsman, design and detail, winders, hoists, haulage gears and general mining machinery, DESIRES progressive POST. Not afraid of hard work.—Address, P9689, The Engineer Office. P9689 B

WORKS MAINTENANCE ENGINEER (45), 18 years as chief with large engineering and manufacturing firms, OPEN to ENGAGEMENT with up-to-date firm, or would consider any responsible position. Salary £500 per annum.—Address, P9688, The Engineer Office. P9688 B

DRAUGHTSMAN (40) DESIRES POST; 20 Years' general exp. D.O., 6 years shops, 6 years leading draughtsman.—Address, P9690, The Engineer Office. P9690 B

A REAL LIVE MACH. SHOP or WORKS FOREMAN of proved ability REQUIRES POST; 20 years' experience, 12 years executive, mech. and elect.; expert knowledge of modern shop practice, costs, layouts, &c.; keen, tactful, effective and economical control of labour. Good refs.—Address, P9653, The Engineer Office. P9653 B

FOREMAN MOULDER (STEEL) is OPEN for CHANGE of ENGAGEMENT; 30 years' experience with large founders as head foreman and handling large numbers of men; experienced in locomotive, valves, engine, general castings and moulding machines; also in the manufacture of the largest ships' castings cast in the United Kingdom; references.—Address, "MOULDER," Wm. Porteous and Co., Glasgow. P9681 B

PARTNERSHIPS

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A PARTNER or PARTNERSHIP

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Established over 70 years.

ENGINEER, with Some Commercial Knowledge, REQUIRED as PARTNER in small but long-established Foundry (London). Capital secured about £100. Salary and commissions. Every investigation.—CALDER and ANDERSON, Consulting Engineers, 7, Wardour-street, London, W. P9692 C

PARTNERSHIPS

ENGINEER REQUIRED as ACTIVE DIRECTOR in established parent company developing an international business. Clients include Governmnet Departments, shipping companies, and leading commercial firms. Investment £5000. Open to full investigation by solicitors and accountants.—Write, Box B7550, Franses and Co., 131, Fleet-street, E.C. 4. 7192 C

EXPERIENCED ENGINEER DESIRES PARTNERSHIP in sound engineering business, or would PURCHASE OUTRIGHT. Must be open to expert examination, London district, or within 20 miles; £3000 to £5000 available. Principals only.—Address, P9685, The Engineer Office. P9685 C

EDUCATIONAL

A M.I.C.E., A.M.I.M.E., B.Sc., AND ALL ENGINEERING EXAMINATIONS.—All my students have my personal attention. Thousands of successes during the past nineteen years. Courses can be commenced at any time. Please note change of address.—G. P. KNOWLES, M.B.E., B.Sc., A.M.I.C.E., &c., Parliament Mansions, Victoria-street, Westminster, S.W. 1. Ex. B

CORRESPONDENCE COURSES for Inst. C.E., Inst. Mech. E., London Univ. (Matric., Inter., B.Sc.), and ALL ENGINEERING EXAMINATIONS, personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours) Eng., London, Assoc. M. Inst. C.E., Chartered Civil Engineer, M.R.S.I., F.R.S.A., &c. Also Day Tuition in Office. Excellent results at all Exams., comprising hundreds of Successes. Courses may commence at any time.—Apply to Mr. TREVOR W. PHILLIPS, B.Sc. (Hons.), A.M.I.C.E., &c., 6/11, TRAFFORD CHAMBERS, 58, SOUTH JOHN STREET, LIVERPOOL. Ex. B

ENGINEERING DRAWING.—Special Postal Course in Engineering Drafting. Enrol now. Fee three guineas for the complete course. Also day tuition in office by qualified teacher. Established 1895.—PERCY PITMAN, M.I. Mech. E., 25, Victoria street, London, S.W. 1. 7037 B

ENGINEERING SALESMANSHIP AND SALES MANAGEMENT.—Write for brochure describing our Special Course of Training for posts of unlimited scope in this lucrative field.—THE INSTITUTE OF ENGINEERING SALESMANSHIP, 333, Oxford-road, Manchester. 7127 E

SURVEYING AND LEVELLING.—EXCELLENT OPPORTUNITY to ACQUIRE thorough practical INSTRUCTION on WORK.—Address, E. MOUL, Hollybank, Woking. P9627 E

MISCELLANEOUS

TRANSLATIONS, to or from Any European Language, accurately executed by Technical Staff; also Typing or Facsimile Printing of Specifications Contracts, Letters, &c.—DANKS and Co., 17-95, Strand, W.C. 2. Tele., City 6110. P9615 I

PATENTS

FOR SALE, a Valuable PATENT PROCESS for CASTING HIGH-SPEED STEEL (Tungsten) for tools, i.e., milling cutter lathe tools, &c.; also large quantity of METAL PATTERNS for same.—Address, P9661, The Engineer Office. P9661 B

THE OWNERS of PATENTS Nos. 102,624, Relating to "Improvements in Multi-cylinder Motors, with Radially Arranged Cylinders"; 128,653, for "Improvements relating to Internal Combustion Engine Valve Mechanism"; 140,529, for "Improvements in Connecting-rod Big Ends for Internal Combustion Engines"; 140,546, for "Improvements in Shock Absorbers for Aeroplane Radiators"; 145,398, for "Improvements in Springs for the Valves of Explosion Motors," are DESIROUS of NEGOTIATING with interested parties for the GRANTING of LICENCES thereunder on reasonable terms.—For information, apply to Messrs. LLOYD WISE and CO., Chartered Patent Agents, 10, New Court, Lincoln's Inn, London, W.C. 2. 7205 B

THE PROPRIETOR of BRITISH PATENT No. 176,914, dated December 23rd, 1920, relating to "Improvements in Pulp beating Engines," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above PATENT and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 7194 B

THE PROPRIETORS of PATENTS No. 24,307 of 1913, for "Improvements in Locomotive Steam Engines," and No. 5861 of 1915, for "Improvements in Boilers for Locomotive Steam Engines," are DESIROUS of DISPOSING of the PATENT RIGHTS or of NEGOTIATING for the GRANT of LICENCES to work thereunder.—For particulars, apply to G. F. REDFERN and CO., Chartered Patent Agents, 15, South street, Finsbury, London, E.C. 2. 7204 B

THE PROPRIETOR of BRITISH PATENT No. 26,296/13, dated November 17, 1913, relating to "Sheet Metal Culverts," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, 22, East Jackson Blvd., Chicago, Illinois. 7151 B

PATENTS

PATENTS AND DESIGNS ACTS, 1907 AND 1919. THE Proprietor of BRITISH PATENT No. 24,018 of 1913 is PREPARED to SELL the PATENT or to LICENCE British Manufacturers to work thereunder. It relates to "Apparatus for Utilising the Movement of Sea Waves to Pump Water for Operating Hydraulic Motors."—Address, B. W. and T., 112, Hatton-garden, London, E.C. 1. 7219 B

THE PROPRIETORS of PATENT No. 158,729, "Improvements in Mechanical Stokers," are DESIROUS of ENTERING into ARRANGEMENTS by way of LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the same and ensuring its full development and practical working in this country.

All communications should be addressed in the first instance to J. E. EVANS-JACKSON and CO., Registered Patent Agents, Bath House, 57/60, Holborn viaduct, London E.C. 1. 7174 B

THE PROPRIETORS of the BRITISH PATENTS Nos. 24,162/14, for "Steam Generators," and 6390/13, for "Improvements in and relating to the Tubes of Tubulous Steam Generators," are DESIROUS of ENTERING into NEGOTIATIONS for the SALE of the PATENTS or for the GRANT of LICENCES thereunder.—Any inquiries to be addressed to C. and R., 24, Southampton-buildings, London, W.C. 2. 7228 B

THE Proprietor of BRITISH PATENT No. 6404/13, for "Method of and Apparatus for the Pressing of Mouldings in Fibrous Material Agglomerated by means of an Adhesive Matter or Agglutinant," DESIRES to INTRODUCE his INVENTION to the notice of manufacturers and others with a view to the invention being worked commercially under Licence or otherwise.—All communications to be addressed to Messrs. JENSEN and SON, Chartered Patent Agents, 77, Chancery-lane, London, W.C. 2. 7220 B

MACHINERY, &c., WANTED

WANTED, a SET of THREE-THROW DEEP WELL PUMPS, for 30,000 galls. per hour, to pump out of a well 110ft. deep, 10ft. dia., and deliver into a reservoir 200ft. above ground level; must be in first-class working order; if with engine, direct geared.—W. ROLLINSON and SONS, Ltd., Basford Ironworks, Nottingham. 7207 F

FOR SALE

AIR COMPRESSOR, HORIZONTAL STEAM-DRIVEN INGERSOLL RAND, 14in. by 12in. by 12in., 360 c.ft.; VERTICAL BELT-DRIVEN Broom and Wade, 300 c. ft. per min.; immediate delivery; low prices.—J. T. WILLIAMS and SONS, South Bermondsey Station, London, S.E. 16. 7113 G

AIR COMPRESSORS (THREE), to 3000 lb. per sq. inch; two by Luth and Rosens, driven by 85 H.P. D.C. motor, 230 volts; and one Four-stage ditto, driven by motor, 85 H.P., 220 volts. In very good condition and very low in price. Could be sold separate from motors.—JENNINGS, West Walls, Newcastle-on-Tyne. 7231 G

BELT-DRIVEN "TANGYES" TWO-THROW RAM PUMP, 5½in. dia. rams, approx. 4000 g.p.h.

Belt-driven TWO-THROW GEARED RAM PUMP rams 4in. dia. by 6in. stroke, cap. 3000 g.p.h.

2 Vertical TWO-THROW GEARED Belt-driven RAM PUMPS, 4in. dia. ram by 4in. stroke, cap. 1000 g.p.h. at 60 revs.

Horizontal Duplex STEAM PUMP, 16in. by 7in. by 10in., by Worthington.

TREBLE-BARREL DEEP WELL PUMP, 5in. bore by 14in. stroke, with pumping frame, suitable for direct steam or belt drive.

3 New Electric-driven "REES ROTURBO" PUMPS, 1000 g.p.h., for 440 volts D.C.

Horizontal COMPOUND STEAM ENGINE, h.p. cyl. 9in., l.p. cyl. 14½in. by 14in. stroke.

Horizontal Single-cylinder STEAM ENGINE, 10½in. cyl. by 20in. stroke.

STEAM CAPSTAN, by Clarke-Chapman, 6in. dia. cyls.

2 Vertical AIR RECEIVERS, with dished ends, 7ft. high by 6ft. 8in. dia. by 3-8in. plate.

RADIAL DRILLING MACHINE, with arm 6ft. 6in. long, auto. and hand feeds.

8in. centre LATHE, S.S. and S.C., 8ft. gap bed.

New 6in. centre LATHE S.S., S.A. and S.C., 6ft. gap bed

STANLEY ENGINEERING CO., Bath. Ex.

BOILER, VERTICAL COCHRAN, 14ft. High by 7ft. dia., 145 tubes, 2½in. dia., 3500 lb. evaporation, mountings and fittings, 100 lb. pressure.—Particulars from J. T. WILLIAMS and SONS, South Bermondsey Station, London, S.E. 16. 7114 G

DIESEL ENGINES.—The Following are for IMMEDIATE DISPOSAL at about one-fourth usual prices:—

TWO 1200 H.P., by Krupp, two-stroke, 6-cylinder.
ONE 1600 H.P., by Krupp, four-stroke, 6-cylinder.
TWO 800 H.P., by Krupp, four-stroke, 6-cylinder.
Also D.C. DYNAMOS for above, 230 and 500 volts.
JENNINGS, West Walls, Newcastle-on-Tyne. 7233 G

DOUBLE-ENDED PUNCHING, SHEARING and ANGLE CROPPING MACHINE, Cameron, for 1in. plate, 30in. gaps, 4½in. angle shears at side, driven 10 H.P. motor, 460 volts, overhead cranes, &c.; fine tool; immediate delivery.—J. T. WILLIAMS and SONS, South Bermondsey Station, London, S.E. 16. 7112 G

EXHAUST TURBINE GENERATING SET, 600 K.W., Brush-Parsons, 230 volts, D.C., with full surface condensing plant, valves, piping, oil separator, &c.; excellent condition and very low price. —JENNINGS, West Walls, Newcastle-on-Tyne. 7229 G

FOR SALE

FOR SALE, LANCASHIRE BOILERS (3), by Horsfield's, Dewsbury, 30ft. long by 8ft. dia., no cross tubes, guaranteed for 160 lb. pressure. All mountings and fittings.—WILLIAMS, 37, Queen Victoria-street, London. 7107 G

FOR SALE, LANCASHIRE BOILERS (2), by Danks, 30ft. long by 8ft. 6in. dia., with Hopkinson's fittings, for 160 lb. pressure. Low price before removal.—WILLIAMS, 37, Queen Victoria-street, London. 7108 G

FOR SALE, ECONOMISER, by Green's, 512 Pipes, new 1916, guaranteed to re-insure for 160 lb. pressure. All fittings as now fixed.—WILLIAMS, 37, Queen Victoria-street, London. 7110 G

FOR SALE, LANCASHIRE BOILERS (2) by Gimson's, Leicester, 30ft. long by 8ft. 6in. dia., no cross tubes, for 160 lb. pressure. Low price before removal.—WILLIAMS, 37, Queen Victoria-street, London. 7109 G

FOR SALE, LANCASHIRE BOILERS (2), by Yates and Thom's, 30ft. long by 8ft. 6in. dia., with Hopkinson's fittings, for 160 lb. pressure. Practically new.—WILLIAMS, 37 Queen Victoria-street, London. 7106 G

FOR SALE, New 7½-Ton ELECTRIC CAPSTAN, direct driven by 60 H.P. Laurence-Scott Motor, 220 volts, enclosed in Tank, 12ft. by 6ft. by 4ft., makers, Stothert and Pitt.—WILLIAMS, 37, Queen Victoria-street, London. 7232 G

FOR SALE, New COLD IRON CIRCULAR SAW MACHINE, by Clifton and Waddell, with Ten New Saws, 26in. dia., and fittings.—WILLIAMS, 37, Queen Victoria-street, London. 7235 G

FOR SALE, New 5-Cwt. PNEUMATIC POWER HAMMER, by Pilkington, Type 65, with all fittings, immediate delivery.—WILLIAMS, 37, Queen Victoria-street, London. 7244 G

FOR SALE, ONE Excellent 5 Ton Grafton SHUNTING CRANE, new in 1918, and in perfect condition.—JOSEPH PUGSLEY and SONS, Ltd., Cattybrook Ironworks, Lawrence-hill, Bristol. 7215 G

FOR SALE, THEODOLITES, DRAWING INSTRUMENTS, SECOND-HAND. CLARKSON'S, 338, High Holborn, W.C. (Opposite Gray's Inn-road).

FOR SALE, LEVELS, DRAWING INSTRUMENTS, SECOND-HAND. CLARKSON'S, 338, High Holborn, W.C. (Opposite Gray's Inn-road). Ex. G

FOR SALE, VENTILATING PLANT, as Following:—ONE OPEN RUNNING WADDLE FAN, with Single Horizontal Engine, Fan 23ft. dia., for 40/50,000 c. ft. per min. at 2in. water gauge; steam cylinder 24in. diameter by 24in. stroke; engine and fan made by the Waddle Fan Co. Can be seen running by appointment.—Apply, CONSETT IRON CO., Ltd., Consett, Co. Durham. 7185 G

GENERATING SET.—250 K.W. RUSTON CROMPTON, as generating electric current for Empire Exhibition authorities; may be seen on load daily, Stand 21, Avenue G/7, Bay 25/24, Palace of Engineering. FOR DISPOSAL, 1st November next. Complete set with accessories or Ruston Oil Engine separate. On present site or transferred and re-erected at buyer's works.—Full specification No. 16,301. Consulting Engineer's report, and test figures from RUSTON and HORNSBY, Ltd., Lincoln. Special runs by appointment. 7213 G

GUN-METAL CENTRIFUGAL PUMPS, Practically new, driven by D.C. motors, 200/300 volts:—

FIVE 3½in. outlet,	8 H.P. motor.	
ONE 3½in.	.. 16 H.P.	..
FOUR 2½in.	.. 4 H.P.	..
FOUR 2½in.	.. 4 H.P.	..
TWO 2½in.	.. 7 H.P.	..
FOUR 2in.	.. 7 H.P.	..

Also SEVEN TWO-THROW RAM PUMPS (Gun-metal) driven by D.C. Motors, 200/300 volts. Low price.—JENNINGS, West Walls, Newcastle-on-Tyne. 7235 G

HIGH-SPEED STEEL, 3-8in. to 3in. Diameter, 5-16in. to 2½in. square, 5-8in. by 3-8in. to 3in. by 1¼in. flats, best Sheffield makers, cheap.—W. and H. COOPER, Ltd., Brady-street, Bethnal Green, E. 1. 'Phone, Bishopsgate 1080. 6987 G

HORIZONTAL CLASS L.H.C. COMPOUND DROP VALVE STEAM ENGINE, by Marshall, 213 H.P., rope fly-wheel, full details.—HARRY H. GARDAM and CO., Limited, Staines. 7131 G

LOCO. TYPE BOILER, Davey-Paxman, Re-insured 160 lb. w.p., 33 H.P., all fittings, injector and chimney. Low price.—Particulars TAYLOR and WILSON, Engineers and Contractors, 20, Queenhithe, Upper Thames-street, London, E.C. P9691 G

LOCOMOTIVES FOR SALE.

Two Nearly New 6 Wheels Coupled Locomotives, by Avonside Engine Co., 14½in. cyls., 20in. stroke, 160 lb. pressure, wheels 39in. dia., steam and hand brakes, standard gauge.

One Ditto 6 Wheels Coupled, by Baldwins, 16in. dia. cyls. by 24in. stroke, wheels 48in. dia., steam and hand brakes, 160 lb. pressure, new about 1917.

One Ditto 6 Wheels Coupled, by Baldwins, 18in. dia. cyls. by 24in. stroke, 150 lb. pressure, wheels 46in. dia., new about 1917.

CAPSTANS.—

Three Electric Capstans, by Ransomes and Rapier, each to haul about 40 tons on straight level track, and self-contained with 6.75 B.H.P. Motor, 210 volts D.C., foot control.

BOILERS.—

Two Babcock and Wilcox Water-tube Boilers, each 8000 lb. per hour, 165 lb. pressure, new 1917, chain grate stokers and superheaters, splendid condition.

Two Lancashire Boilers, each 30ft. by 8ft., for 120 lb. pressure, hand fired, by Ruston Proctor and Danks respectively, each with superheater.

One 288 Tube Economiser, in two 144-tube sections, which can be worked separately, one by Green's in 1917 and one by Clay Cross Co. in 1919, 120 lb. pressure.

One 200 H.P. Robey Patent Compound Superheated Overtype Engine and Boiler combined with jet condenser, cylinders 12½in. and 21½in. dia. by 18in. stroke, giving 216 B.H.P. continuous maximum and 240 B.H.P. emergency, 160 lb. pressure, only worked about two years, fly-wheels 7ft. dia. by 13in. face. This set drives by belt 170 K.W. Three-phase Alternator, 220 volts, 40 periods, 600 r.p.m., and is for sale with or without same.

ELECTRICAL.—

Two Fine 187.5 K.V.A. Steam-driven Generating Sets; engines by Browett Lindley, double cylinder, about 12in. by 12in. cyls., direct coupled each to 200-volt, 3-phase A.C. Generator, by Bruce Peebles, 50 periods, 540 amps., 428 r.p.m., with D.C. Exciter, 50/110 volts, and Switchboards. These two engines, together with the two Babcock boilers mentioned in this advertisement, form two complete stations.

GEO. COHEN, SONS and CO., Ltd., 600, Commercial-road, E. 14, London. Ex

NEW 300 B.H.P. M.A.N. STATIONARY DIESEL ENGINE with accessories as delivered from makers under Peace Treaty, £1450, also Dynamo for same, seen London; also other sizes.—HIGH-DIESEL OIL ENGINES, Limited, 70, Queen-street, E.C.4. 7083 G

"SENTINEL" AIR COMPRESSOR, No. 2 Size, series 14B, w.c. Steel receiver, 33in. dia. by 6ft., capacity 122 c. ft. free air per min., direct coupled to 30 H.P. ventilated motor, 480 volts, 55 amps., 400 revs., starter, cut-outs, by the English Electrical Co.; brand new set.

Gas-heated ANNEALING FURNACE, by the Richmond Co.; cast iron casing, 4ft. by 3ft. 2in. by 2ft. 6in., brick lined, eight burners; new.

Both cheap to save removal.

POLLOCK, BROWN and CO., Southampton. P9633 G

For continuation of For Sale Advertisements see page 3.

Opportunity for Swiss Engineers Abroad.

Swiss Engineering Works has vacancy in its

Refrigerating Machinery Department

for energetic experienced engineer, fully acquainted with all systems of refrigerating machinery, qualified for

Superior Post.

Apply, giving full particulars, languages spoken, education, previous employment, salary required, references, and copies of testimonials, to Box Z. G. 2374, at the offices of this paper.

A Seven-Day Journal

Colliery Ropes.

THE official report on the disaster which occurred at the Nunnery Colliery on December 3rd, 1923, and in which seven men lost their lives, was issued by the Mines Department some days ago. The accident happened on the Silkstone Main haulage plane, and was caused by the breakage of a part of the haulage rope, which had been in service for 19½ months. Similar ropes had, however, been used for longer periods without accident, so the management is not blamed for the broken rope. The report recommends that the provisions of the Coal Mines Act should be amplified so as to require a daily examination of all plant used for hauling men below ground. That splicing of ropes used for the haulage of persons on inclined planes should be prohibited; that the maximum life of ropes used for the haulage of persons on inclined planes should be limited to 18 months; that an effective safety appliance to arrest the set in the event of the rope breaking should be installed on every train or set used for hauling persons on inclined planes underground; that the question of a factor of safety for passenger haulage ropes, and, as a corollary, the question of making inquiry into the use and manufacture of such ropes, should be referred to the Safety in Mines Research Board for advice; that the provision of a separate road for the haulage of men is a matter deserving the consideration of mine managers.

Steel Houses.

To the names of the several well-known engineering and other authorities interested in schemes and plans for the erection of steel houses, we have now to add that of Lord Invernairn, chairman of William Beardmore and Co., Limited. Speaking last week at the annual general meeting of his company, he referred to the proposals now being advanced for the manufacture and erection of steel houses, as being of considerable interest to the steel industry generally, and to his firm in particular. He saw no reason, he said, why the steel house should not be used to meet the annual demand for some 200,000 houses. Such a course would result in the creation in an entirely fresh quarter of a market for approximately a million tons of steel a year. A requirement of that order, he remarked, would go far to revive the whole steel trade of the country, and, when the quantity of coal and iron ore required to meet it was taken into account as well, would do much in the way of relieving unemployment. His company, he remarked, had gone very fully into the subject, and was now, he thought, in a better position than any other individual firm in the country to meet the demands of the new development. The Duke of Atholl, we notice, has also become interested in the steel house, an example of which, made to the designs of his Grace, was shown at a domestic welfare exhibition which he opened at Glasgow on Monday.

Salving the Laurentic's Treasure.

THE Government salvage steamer Racer has now returned for the season to Portsmouth from Lough Swilly, where for the past few summers she has been engaged on salving the bullion from the Laurentic, sunk during the war. This season's work marked the end of the operations, for over 99 per cent. of the £5,000,000 worth of treasure on board the liner when she went down has now been recovered, and safely restored to his Majesty's Treasury. The Racer has been at work this year since the beginning of April, and has recovered 129 of the 154 bars of gold which remained buried in the wreck. The salvage of these bars proved a much more arduous and trying job than did the recovery of the earlier portions, for the bars had fallen through holes in the hull and become buried in the sea bottom beneath the wreck.

German Munition Factories.

ALTHOUGH the Treaty of Versailles forbids or restricts the production of munitions in German factories, it would appear that German firms are still able to supply, to whomsoever may want them, armaments, warships, submarines, aeroplanes and airships, and have taken steps to keep their trained *personnel* practically intact. According to a report from Constantinople, one German company has offered to build and deliver to Turkey an up-to-date submarine. It would appear that in order to avoid the stipulations of the Treaty, many German armament and munition firms have removed their works or established branch undertakings in different "neutral" countries beyond the reach of the Allies' Commissions of Control. Krupps have, for instance, an armament works in Sweden. The Vulkan and Blohm and Voss undertakings have established branches at Barcelona, an important Diesel engine factory has moved its works across the Swiss frontier, and the Goerz Company now makes submarine periscopes at Vanloo, in Holland. The Friedrichshafen airship works, to be virtually closed now that the ZR3 has left for America, are to be continued, it would appear, in another guise at Seville, Stockholm and Akron (Ohio), while many of the aeroplane factories have firmly established themselves outside the boundaries of the Fatherland. In the case of the Turkish submarine, it is reported that the hull fitments, armament and engines will be built at one or other of these establishments and shipped for assembly in Turkey.

French Naval Construction.

WHILE the state of the French national finances has necessitated the carrying out of a severe policy of retrenchment in order to reduce the threatened heavy deficit of the forthcoming Budget estimates, the Minister of Marine is of the opinion that such economies should not affect his department. M. Dumesnil will shortly present a plan to the Budget Commission for the consolidation of the navy in the sense that the existing programme of naval construction will be completed by the addition of such vessels as are now lacking, by which is probably meant the construction of battleships. All the old vessels are to be scrapped and replaced by new units. M. Dumesnil will ask the Budget Commission to provide yearly grants over a long period for the building of a homogeneous navy which will be sufficiently strong for all purposes of defence. At the same time, he refuses to transfer to private shipyards the work which, he argues, should be confined as much as possible to the arsenals, and for that reason he proposes to reorganise the arsenals and run them along purely industrial lines. This revived activity in the reconstitution of the navy coincides with the interest which has been shown in France in the concentration of the British Fleet in the Mediterranean. The strategical necessity of such a concentration is recognised, but the French argue that they should be in a position to hold their own in any emergency.

Shipbuilding Employers' New President and Vice-President.

AT the annual meeting of the Central Board of the Shipbuilding Employers' Federation, held at Carlisle on Friday last, Mr. John Barr was elected president, in succession to Mr. Grant Barclay. The newly elected president is chairman of the Barrow Shipbuilders' Association and a special director of Vickers Limited, Barrow-in-Furness. He has served as a member of the Management Committee of the Engineering and Allied Employers' National Federation, and as a director of Vickers-Petters, Limited, of Ipswich. Mr. A. J. Campbell, of William Beardmore and Co., Limited, of Dalmuir, was elected to the vice-presidentship rendered vacant by the promotion of Mr. Barr. The other two vice-presidents are Mr. J. T. Batey, of Hawthorn, Leslie and Co., Limited, and Sir Andrew R. Duncan. Mr. Campbell is president of the Clyde Shipbuilders' Association, and is a native of Clydebank. He received his early training at the yard of J. and G. Thomson, which later was taken over by John Brown and Co., Limited, and from Clydebank he went to Spain for Palmers, Limited, of Jarrow-on-Tyne. After returning from Spain Mr. Campbell was appointed shipyard manager at Vickers, and again in 1909 he was chosen to assist the Spanish Government with the remodelling of arsenals and the building of naval vessels at Ferol. He joined Messrs. Beardmore at the Naval Construction Yard, Dalmuir, in 1912.

Dock Extensions at Southampton.

THE announcement that the Southern Railway Company shortly intends to make a beginning with its £13,000,000 dock scheme at Southampton is a significant one from the point of view of the future welfare of that port. It will be remembered that this scheme was first discussed about two years ago, and that it has been prepared by Major G. S. Szlumper, the Southern Railway Company's marine and docks manager at Southampton, and by Mr. F. E. Wentworth Shields, M. Inst. C.E., docks engineer. Operations will be begun within two to three months near Rye Pier, where land is to be reclaimed by filling in the present mud flats. This preliminary work is to be carried on in accordance with arrangements made with the Southampton Corporation, whereby part of the land reclaimed will be rendered available for the town's use. The first part of the dock scheme proper is to include the making of two 1000ft. jetties with a depth of about 45ft. of water at L.W.O.S.T. A new channel 600ft. wide will permit of the berthing of the largest liners without the ships having to change their course, as is necessary in the case of the present ocean dock, which lies at right angles to Southampton Water. It is expected that the first part of the scheme will be completed and ready for the reception of traffic within five years of its commencement. The second part of the scheme provides for the building of three further 1000ft. jetties, and there is expected to be enough land between the new docks and Millbrook Point for two further jetties and two graving docks. Such works, however, will only be undertaken after the first two jetties are finished, and if further demands for accommodation have to be met. The docks are to be equipped with the latest cargo and grain-handling machinery, and with this end in view a deputation of Southern Railway engineers, with Mr. G. R. Newcombe, assistant docks engineer, is at present visiting the chief continental ports.

A Large German Diesel Engine.

A GERMAN shipbuilding journal states that a Diesel engine now under construction in the Blohm and Voss shops at Hamburg will be the largest of its type in the world. This engine has been ordered by the Hamburg Electricitäts-Werke for its new power station, and is to drive a three-phase generator with a capacity of 10,000 kilowatts, which is being manufactured by the Siemens-Schuckert Company. The engine is being built under license from the Maschinenfabrik Augsburg-Nürnberg. It is of the double-acting two-stroke cycle type, with port scavenging, and has nine cylinders, each of 860 mm. bore and 1500 mm. stroke, and is designed to develop 15,000 brake horse-power at 93.75 revolutions a minute. According to the same journal, the largest oil engine now existing is a double-acting four-stroke cycle marine motor on the Burmeister and Wain principle. This engine has eight cylinders of 840 mm. bore and 1500 mm. stroke, and develops about 8000 brake horse-power at 125 revolutions. This is equivalent to an output of 1000 brake horse-power from each cylinder, whereas the new German engine is to develop 1670 brake horse-power per cylinder at fewer revolutions and with a much reduced piston speed. With the addition of reversing gear it would at once become available for propelling a ship. In this connection the growing popularity of the motor ship in Germany deserves to be noticed. The latest returns of Lloyd's Register show that out of a total of 378,522 tons of shipping now under construction in that country, 279,226 tons are motor ships.

The Donaldson Motor Ship Moveria.

ON Friday last there was launched from Vickers Naval Construction Works at Barrow the new motor-propelled cargo ship Moveria, which has been built to the order of the Donaldson Line, Limited. This vessel is interesting, both on account of her hull construction and her propelling machinery. She has the following principal dimension:—Length, 398ft.; breadth, 51ft. 6in.; loaded depth, about 27ft.; with a deadweight capacity of 7500 tons. She has been specially designed to carry general cargo and cattle, and the accommodation includes refrigerated space. A hull of the transverse frame type was adopted, but the double bottom was built on the Vickers-Wingate longitudinal braced frame system, which, it is claimed, maintains the hull strength, but at the same time permits a lighter and more open construction than usual to be employed. The main propelling machinery consists of a single eight-cylinder Vickers four-cycle, single-acting engine, with cylinders 30in. in diameter, with a stroke of 45in. When running at a normal speed of 110 revolutions per minute, this engine is designed to develop 2700 brake horse-power. It will thus be the largest Vickers solid injection type of engine afloat, and will, we learn, embody improvements in detail which have been suggested by the experience gained with similar but smaller engines already constructed by Vickers Limited for oil tanker service.

The Voyage of the ZR3.

AT 6.35 a.m. on Sunday, after many delays and postponements, the German airship Z R 3, built at the Zeppelin works at Friedrichshafen for surrender to the United States, left her home with a mixed German and American complement on her voyage of delivery across the Atlantic. This vessel was described and illustrated in considerable detail in our issue of December 7th last year. She has a length of 200 m., and a gas capacity of about 70,000 cubic metres, is equipped with five Maybach engines of 200 horse-power each, and possesses a normal radius of action at cruising speed of seventy-eight hours, equivalent to 8400 kiloms. Following a route across France and Spain, she traversed the Atlantic by way of the Azores to Nova Scotia, and thence made her way to Lakehurst, New Jersey, where she arrived on Wednesday morning at 9.55. It is understood that the Navy Department will use the vessel to demonstrate the practicability of commercial airship transport in the United States. She is essentially a commercial vessel, being fitted with cabin and other accommodation for twenty passengers, in addition to the crew. No use, however, will be made of her for the transport of passengers until, so it is said, her hydrogen contents have been replaced by helium. The total distance flown by the airship on its passage across to America was 5006 miles, and the time occupied on the trip 81¼ hours, so that the average speed maintained was a little over 61 miles an hour. In the matter of speed the vessel greatly excelled the British airship R34 on her outward trans-Atlantic voyage in 1919, for on that occasion the speed maintained was only 29 miles an hour. In other respects, however, the performance of the German vessel is, all things considered, less noteworthy than that of the British.

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. XXVI.*

GENERAL ENGINEERING EXHIBITS.

Nobel Industries, Limited.

Among an extensive series of exhibits shown by Nobel Industries, Limited, London, in the Palace of Industries, representative of its very varied lines, are two interesting machines of widely different classes which are demonstrated in operation. They are a coining press manufactured by Kynoch, Limited, of Birmingham, and an automatic cartridge case gauging machine, made by Thomas White and Sons, of Paisley.

The whole mechanism of the coining press—which we illustrate by Fig. 487—is surrounded and maintained by a massive casting designed to support a working load of 200 tons, and to deal with coin blanks up to 1¼in. diameter. In this machine the upper die is stationary, and the coin is struck by the rising action of the bottom die. The upper die is contained in a swivelling head, which enables both dies to be exposed for cleaning or inspection in a few seconds. It can be replaced in position for coining without any readjustment. Thus it cannot get out of register. The slight vertical adjustment of the top die to suit various thicknesses of coins is made by a wedge and screw in the head of the press. The reciprocating action of the bottom die is operated by powerful phosphor bronze toggles, working on hardened steel pins. The toggles are held together by floating steel rings. The motion of the toggles is imparted to a cast iron table of heavy construction, which supports the bottom die, feed mechanism and extractor gear. This table slides in adjustable V guides on the main frame. The speed of the machine is from 80 to 100 revolutions per minute, and it has an output of about 4500 coins per hour.

The feed motion consists of a pair of fingers which carry the coin forward from the base of the feed chute to the die. The same movement carries the finished coin to the delivery chute. The stroke of the feed fingers can be varied to suit requirements. The feed motion is protected by a cover plate, which, with the feed chute, is readily removed by slackening three thumb screws, so that fingers and dies can be exposed in a few seconds. The feed motion and extractor are operated by cams on the crank shaft. Means are provided for rapidly releasing the bottom die when necessary to avoid clashing.

The toggles are operated by a steel crank shaft, carrying a heavy fly-wheel, connected to the centre toggle pin by a cast iron connecting-rod, which has an adjustable bearing at the crank shaft end. The crank shaft is supported by bearings cast on the frame and provided with gun-metal half bushes. The fly-wheel is fitted with a foot brake. The machine is usually provided with fast and loose pulleys for belt driving, as shown in the illustration. At the Exhibition, however, it is driven direct by an electric motor through gearing.

The automatic cartridge case gauging machine is illustrated in front and back view respectively by Figs. 488 and 489. In the latter the whole of the mechanism is seen enclosed in a glass panelled case, the condition in which it normally works, and in the former the case has been opened up to show the mechanism.

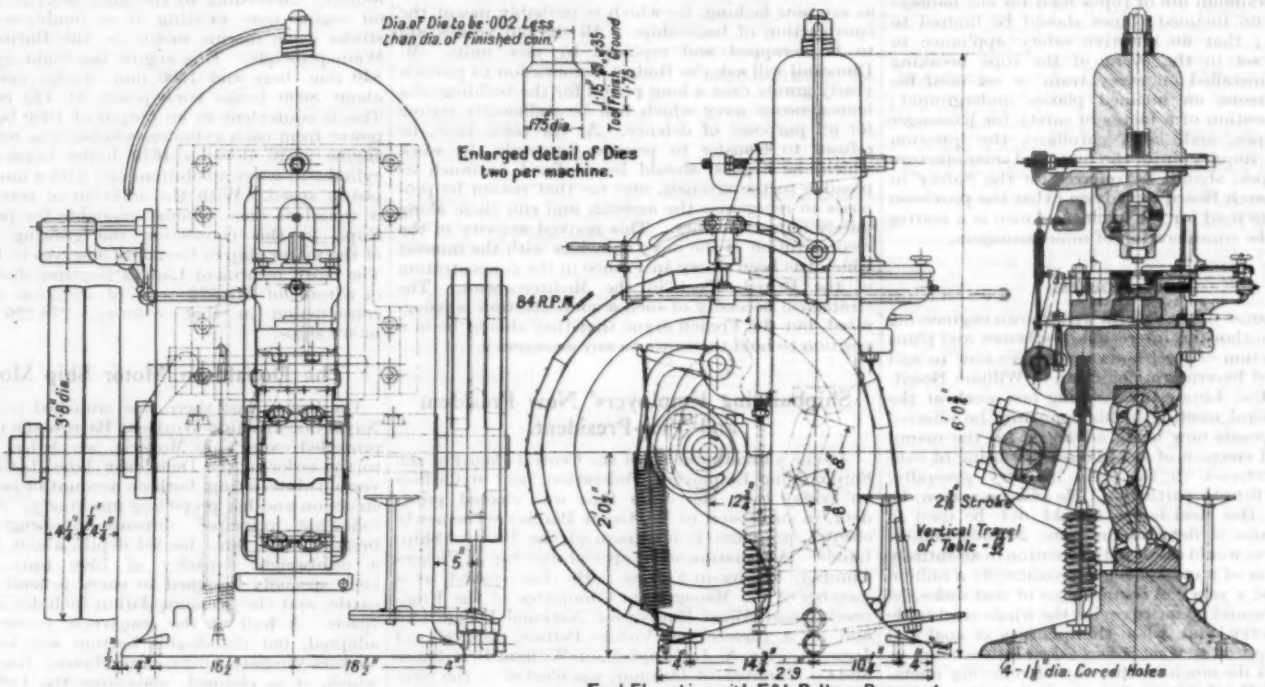
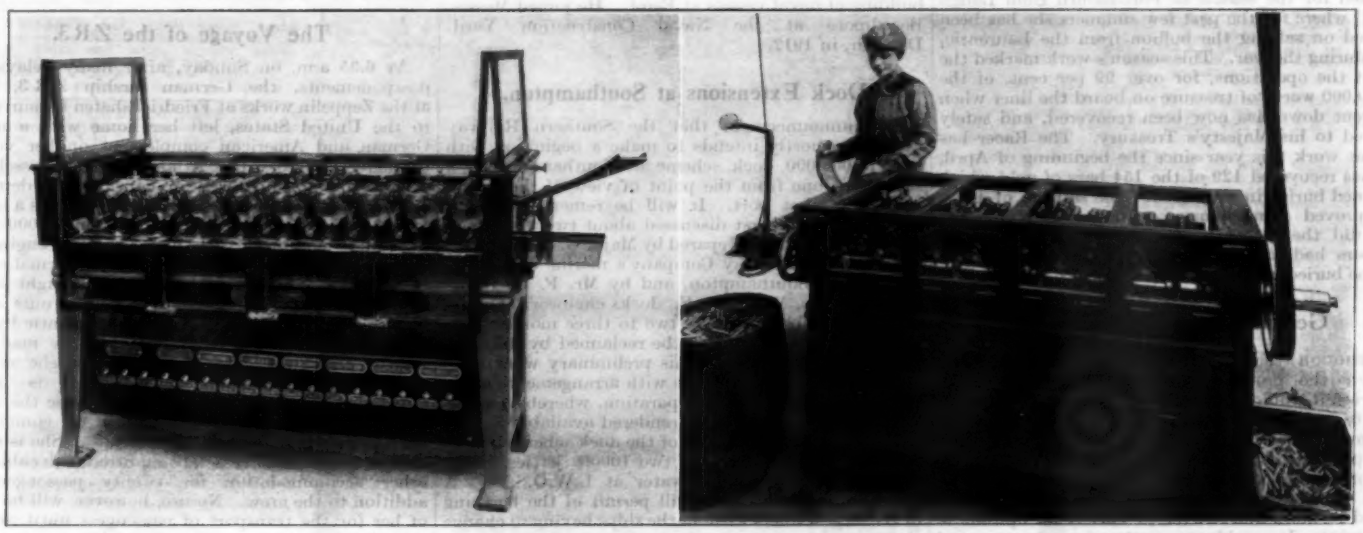


FIG. 487—COINING PRESS—NOBEL INDUSTRIES



FIGS. 488 AND 489—CARTRIDGE CASE GAUGING MACHINE—NOBEL INDUSTRIES

This machine is at once a marvel of dexterity and simplicity, and it is fascinating to watch it in action. It is not merely a gauging machine; it is an automatic inspector. Furthermore, after inspecting each cartridge case for all defects, except quality of metal, it automatically classifies each defect and deposits the defective case in a separate drawer, which is reserved for cases which suffer from that particular defect. A machine of this type may be designed to gauge many different sorts of objects, according to their shapes, but a cartridge case, which must be made with perfect exactitude in all respects, and may err in so many ways, offers a very complete demonstration of its all-round capabilities.

Here we have a series of nine heads, giving eight different tests to which the case is subjected. They are, in the order given—(1) inside diameter of neck,

* No. XXV. appeared October 10th.

(2) overall length, (3) diameter of head, (4) extracting grooves, (5) thickness of head, (6) powder chamber, (7) anvil, and (8) cap chamber.

In the automatic sorting process which follows the gauging, each of these tests, with one exception, is subdivided into two, i.e., for cases which err on the large or small size respectively. As the cases are deposited accordingly, nineteen drawers in all are necessitated.

As shown by Fig. 489, the cases are fed by gravity down a curved trough into the machine, the curve compensating for the taper of the cases, and thus assuring a regular delivery and proper presentation to the first gauge head. The case is received into the groove of a revolving disc which carries it forward to the first gauging head. If the case passes this test satisfactorily an oscillating fork—clearly seen in Fig. 488—takes charge of it, and delivers it into a groove on the second revolving disc, and so on throughout the whole length of the machine, the perfect case only surviving to the end of the transit.

When a case fails to pass the first or any of the subsequent tests, the oscillating fork refuses to receive it, and the defective case drops into one of two drawers according to whether it is above or below the required dimension.

This machine is capable of gauging fifty-four cases per minute, and can be set for any limits required. It can be operated on a limit of two thousandths up and two thousandths down on any one dimension. It is also possible to cut out the action of any one or more of the heads, in which case the circular disc then acts as a conveyor, simply taking the cartridge case forward to the next head.

Tangyes Limited.

Tangyes, of Birmingham, is perhaps one of the most catholic of all the engineering firms in this country, and the stand at Wembley gives evidence of the wide variety of machines it makes; we will, however, on this occasion confine ourselves to a few remarks on the new cold-starting heavy oil engine exhibited there. This engine develops 47 brake horse-power, but units up to 125 horse-power are made with single cylinders, and up to 250 brake horse-power with two cylinders.

The general construction of the cylinder is illustrated by Fig. 490, from which it will be seen that the combustion chamber is a separate casting, symmetrical in form, with the valves arranged vertically above one another. The cylinder liner, it will be noticed, is held in place by the combustion chamber casting, and can be readily withdrawn at the back end of the engine. These engines are specially intended to work on a wide range of fuels, and a new type of spraymaker has been devised for the purpose. With this jet, a section through which is included in the drawing, the spray is given a whirling motion by means of a number of fine tangential grooves, through which the oil is forced at a high pressure.

The engine is started up with compressed air and run for a short time on refined petroleum to warm up the combustion chamber, and is then turned over to the heavy fuel oil. When it is desired to use tar, or similar fuel oils, an auxiliary supply of petroleum is provided to the spraymaker by means of an additional pump.

Tests of these engines quoted by the makers show that they have a fuel consumption of 0.422 lb. per brake horse-power per hour, with an oil of 18,000 B.Th.U. per lb. and a thermal efficiency of 33.5 per cent.; but some tests carried out by Mr. W. A. Tookey show even better results, the fuel consumption having been brought down to 0.385 lb. per brake horse-power per hour.

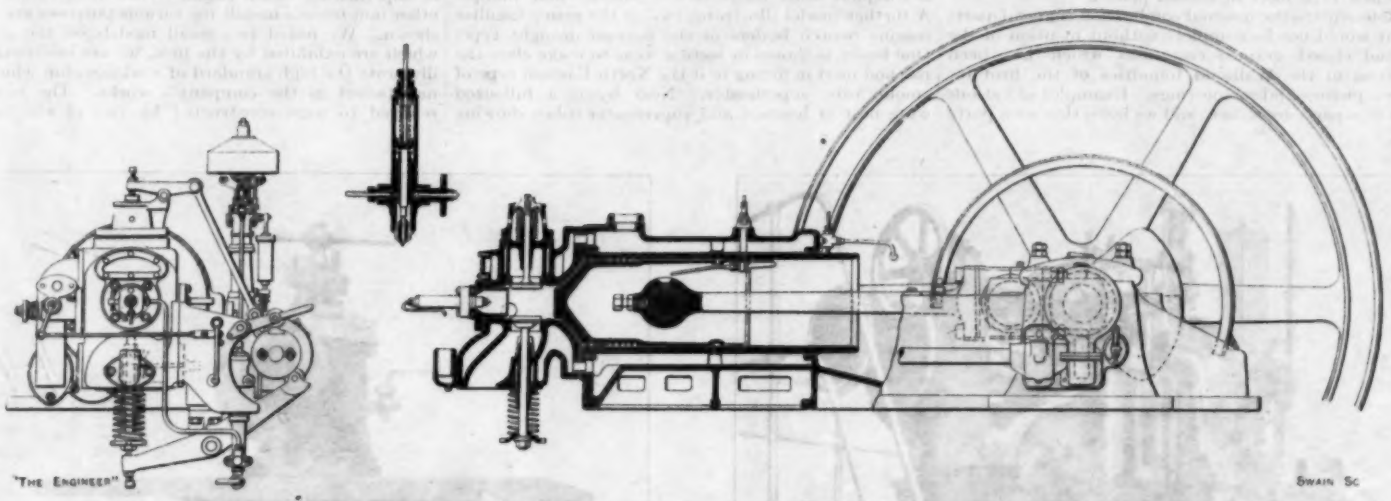
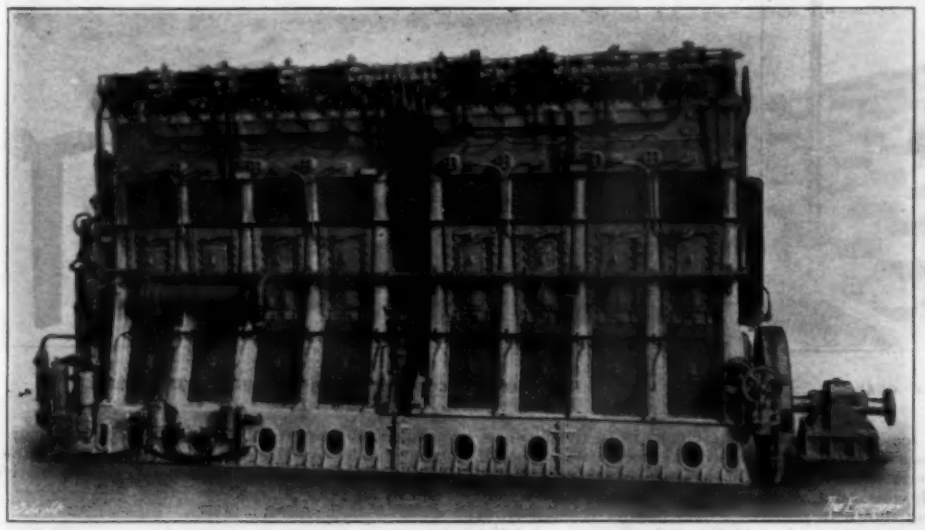


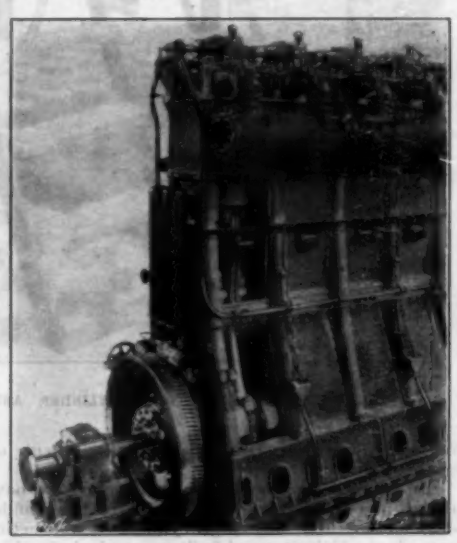
FIG. 490—COLD STARTING HEAVY OIL ENGINE—TANGYES

The North-Eastern Marine Engineering Company, Limited.

On the stand of the North-Eastern Marine Engineering Company, Limited, of Wallsend-on-Tyne and Sunderland, is to be seen a collection of exhibits which is widely representative of British marine engineering practice and some of its latest developments. The firm has built up a high reputation for its reciprocating marine steam engines and its steam auxiliaries for marine and land work, but with the coming of the motor ship it has also devoted attention to the marine oil engine, with very successful results. In this branch of its work it has the advantage of being associated with the Werkspoor Company, of Amsterdam, builders of the first oil-engined cargo ship Vulcanus, and pioneers in the construction of single-acting four-cycle marine oil engines. The North-Eastern oil engine embodies the well-known features of the Werkspoor design, and the firm has already constructed several engines which have been designed to develop about 1400 indicated horse-power in six cylinders when running at a normal speed of about 120 revolutions per minute. At the present time there is approaching completion in the company's Wallsend works an eight-cylinder engine of this same type which is, we are informed, the largest of its kind yet constructed.

A working model of the engine reproduced to one-twelfth scale is a prominent feature on the stand. It is a very finely executed example of the model maker's art, and it was constructed by Twining Models, Limited, of Northampton. The illustrations reproduced in Figs. 491 and 492 show two views of the model and give a good idea of the general appearance of the engine. Fig. 492 in particular shows the crank shaft, crosshead and piston, and also the valve gear. The model is driven by an electric motor and means for demonstrating the reversing of the engine are provided. The actual engine now approaching completion is to be installed in a single-screw ship which was ordered by James Chambers and Co., Limited, of Liverpool. It has eight 28½in. diameter cylinders with a stroke of 51½in., and is designed for an output of 3000 indicated horse-power at a normal running speed of 92 revolutions per minute.





FIGS. 491 AND 492—MODEL OF EIGHT-CYLINDER MARINE OIL ENGINE—NORTH-EASTERN MARINE

More information concerning the details of construction of the standard four-cycle single-acting type of motor are to be gained from an inspection of the sectional main cylinder and valve gear which we illustrate in Fig. 493. This unit comprises one main cylinder complete with a part of the engine beam which supports the cylinders and liners. All the parts are sectioned in such a manner as to clearly show the form of the solid head type of cylinder used and the ample cooling water spaces which are provided. The individual valves are to be clearly seen, and the neat method of transferring the valve operating levers from the ahead to the astern running cams by partly rotating an excentric mounting on the fulcrum shaft upon which the levers are mounted is well demonstrated. In the front of the illustration the cylinder compression release valve, which is employed during the reversing process, may be noted. A feature of the design is the cylinder liner

extension piece, which is seen below the cylinder beam. This part of the liner carries the lubricating connections, and it may be removed so as to give ready access to the piston and to facilitate its examination and removal. The upper part of the model unit comprising the starting and reversing gears is capable of easy inspection from the platform shown. Another model connected with the company's recent internal combustion engine developments is that which illustrates the 750 to 1000 indicated horse-power double-acting single-cylinder four-stroke experimental engine, which was described in THE ENGINEER of May 30th and June 6th of the present year. It will be remembered that the trials of this engine caused considerable interest in marine circles, and it is satisfactory to learn that an order for multi-cylinder engines of this new type have now been placed.

Reference to the internal combustion engine department would not be complete without mention of the special closed grained cast iron which has been evolved in the Wallsend foundries of the firm for liners, pistons and piston rings. Examples of various cast iron parts are shown, and we learn that such parts

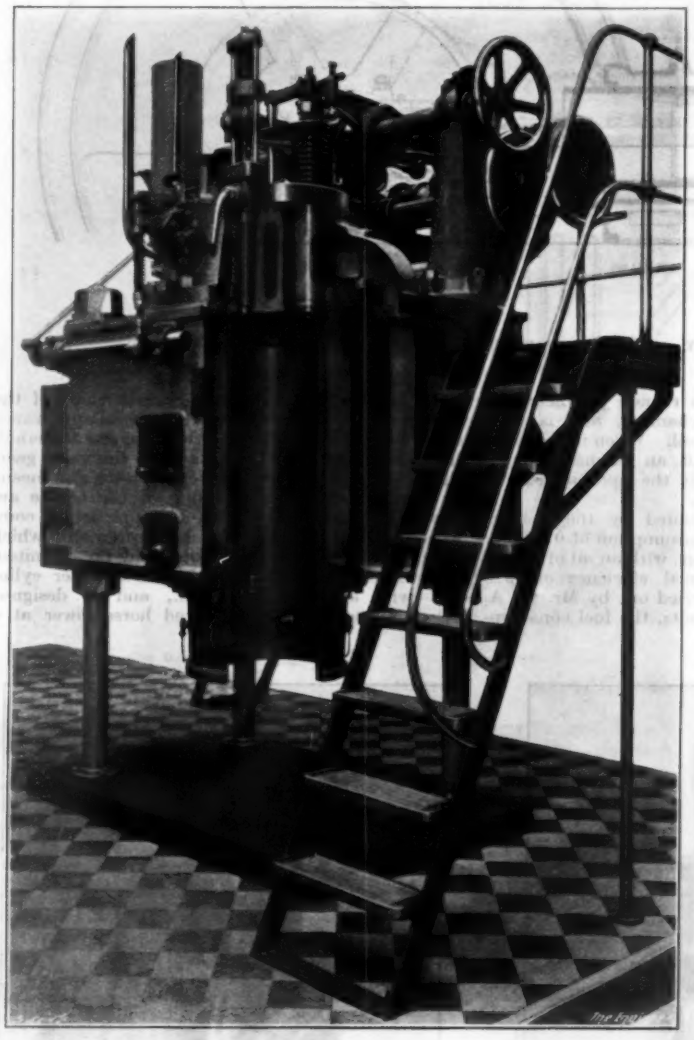


FIG. 493—MARINE OIL ENGINE CYLINDER AND VALVE GEAR

are supplied in large quantities to other marine oil engine builders by the firm.

An outstanding feature of the engines we have already mentioned, particularly the eight-cylinder single-acting and the single-cylinder double-acting units, is the Unity type of built-up crank shaft which is employed. Built-up crank shafts constructed on the Unity system are now, we learn, in use on over fifty steam and motor ships, and sectional examples of such shafts are shown on the stand. It is recognised that the weakest part of a solid crank shaft is at the junction between the crank pin and the web, where a rapid change of section takes place and where the shaft is subjected to heavy stress. To remove the possibility of such weakness the built-up type of marine crank shaft was introduced, and it has now largely displaced the solid type of crank shaft for marine work. Although the danger of total breakdown by actual fracture is greatly lessened, there is always the possibility of disturbing the true alignment of a built-up shaft by very slightly displacing its component parts. The Unity shaft seeks to combine the advantages of the ordinary solid and built-up types and at the same time to eliminate their defects. To do this the crank pin or the journal, as the case may be, is made integral by electrical welding with the solid slab of metal which forms the web. This joint is welded solid to a sufficient depth to give the integral slab and pin sufficient strength to resist maximum torsion, thus producing an equal and unit strength throughout the shaft. Prior to welding the crank webs are shrunk on to the journals and pins in the usual manner, but very little allowance is made for the effect of shrinkage in assessing the strength of the shaft. The new process is the subject of patents by Mr. D. B. Morison, and licences for its manufacture have been granted to the North-Eastern Marine Engineering Company, Limited, and to Richardsons, Westgarth and Co., Limited.

Not less interesting than the exhibits we have described are those illustrating marine reciprocating steam engines and various auxiliaries. Another notable model is that showing to one-twelfth scale a 4000 indicated horse-power quadruple-expansion surface condensing engine of the balanced type, which is complete with its surface condenser and pumps. A further model illustrates two of the firm's familiar marine Scotch boilers of the natural draught type. One boiler is shown in section so as to make clear the method used in fitting to it the North-Eastern type of smoke tube superheater. Near by is a full-sized wing nest of headers and superheater tubes showing the method of jointing the elements to the headers. Illustration Fig. 495 shows a locomotive type of superheater with a header designed to take six banks, each consisting of three elements, one of such banks being shown in position. The header is made from a special cast iron of high tensile strength, and the tube return bends are formed from drop forgings and are welded to the tube elements. There are some sectional specimens of superheated elements which have been in use for ten years, and they are remarkably well preserved.

Another prominent exhibit is the North-Eastern internal steam separator, which we show in Fig. 494, complete with its stop valve. The principle upon which the separator works is that the steam is caused to flow through a series of special elements each consisting of perforated plates. By arranging the plates in a crosswise manner the entering steam is split up into a number of small streams, which are caused to flow through the elements in a sinuous path. Water and solids present in the steam are thus separated out and the water is returned to the boiler, while the clean dry steam passes on to the stop valve. Any solid matter adhering to the plates may be removed by a wire brush when the boiler is cleaned. This useful device is made in standard sizes for single and double-ended boilers, and all parts of it are constructed so that they will readily pass through a 15in. by 11in. manhole. The parts are hot galvanised to resist corrosion.

Other exhibits include examples of the firm's special service pumps, feed-water heaters, and a model of the North-Eastern balanced stop valve. We may perhaps make brief mention of the patented wrapper plate for marine boilers, which is displayed. This wrapper plate is formed in one piece by rolling it in two thicknesses, when it is bent to form the thicker portion of the plate constitutes the bottom or more exposed part of the combustion chamber, while the thinner parts go to make the sides and the top. Only one joint is required, and it is placed near the top. The change in thickness of the main plate is made very gradually; abrupt changes in section are avoided.

We have already referred to the specimens of cast iron exhibited. Some of them are intended for use in superheated steam engine cylinders, and various other non-ferrous metals for various purposes are also shown. We noted two small models on the stand which are exhibited by the firm, we are informed, to illustrate the high standard of workmanship which is maintained in the company's works. The models referred to were constructed by two of the firm's workmen, and they represent a triple-expansion marine engine, made by Mr. W. Hue, and a six-coupled Canadian Pacific Railway bogie passenger locomotive, made by Mr. A. Gilbert.

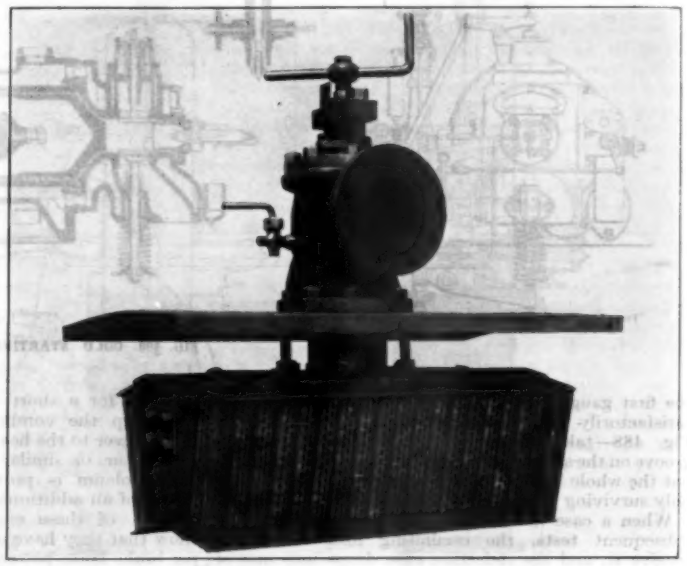


FIG. 494—STEAM SEPARATOR—NORTH-EASTERN MARINE

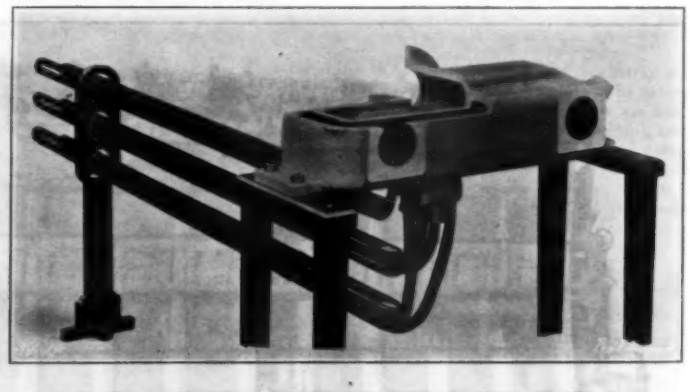


FIG. 495—LOCOMOTIVE SUPERHEATER—NORTH-EASTERN MARINE

ELECTRICAL ENGINEERING EXHIBITS.

FERGUSON, PAILIN, LIMITED.

Armour-clad compound-filled switchgear, suitable for heavy duty in central stations, is to be seen on the stand of Ferguson, Pailin, Limited, of Higher Openshaw, Manchester. It is specially suited for the duplicate bus-bar system and for electrical remote control. In the case of the "H V" unit—shown in Figs. 496, 497, 498—the raising and lowering gear for the oil tank is driven by a reversible electric motor, through bevel gears, and a chain and sprocket device. There are two sets of bus-bars and isolating plugs. The circuit breaker is composed virtually of two breakers with a common set of three terminals connected to the cable box. Two other sets of terminals are connected to the two sets of bus-bars, and normally one breaker is in and the other "out." Only when the switch is used for bus-bar coupling are both breakers in together.

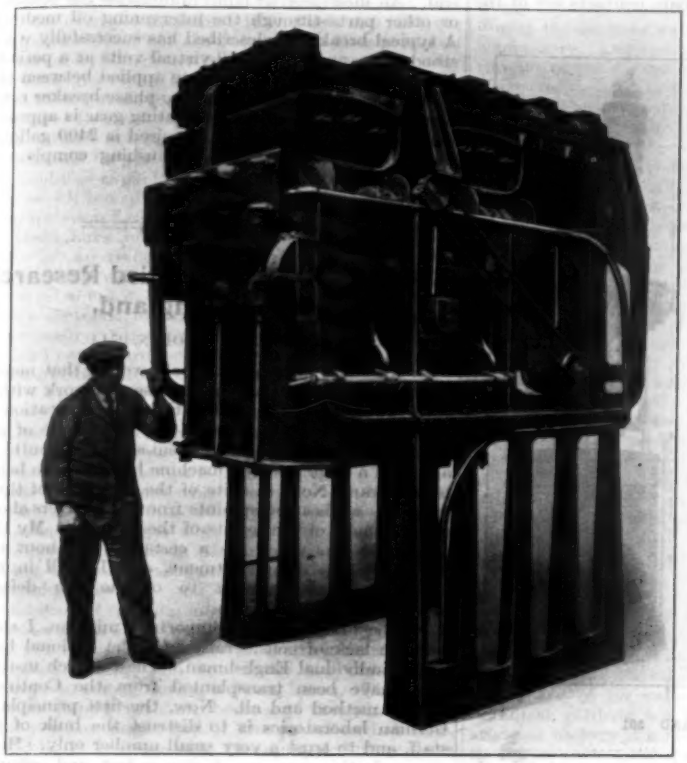
The double breaker system enables one breaker to be used as a standby when there is insufficient

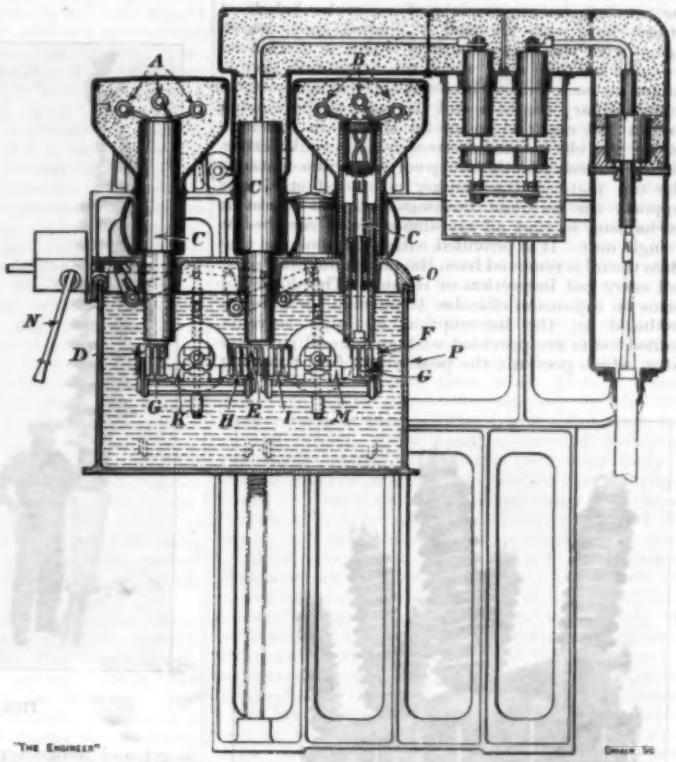
time to inspect the arcing contacts after a heavy fault, the other being put into use on the "hospital" bus-bar immediately. Moreover, if a feeder is down for repairs, it can be connected to the "hospital" bus-bars temporarily until it has been tested, after which it can be quickly transferred to the main bus-bars. Each of the two breakers has its own operating lever and closing solenoid, so that normally the selection of bus-bars is effected from the control board, and as the attendant takes full control of the bus-bar selection, there is fixed responsibility, the change over being made by simple push button control. Automatic indication of the switching operations is given at the control panel, and if desired indicating lamps can also be fitted on the switch unit. To prevent incorrect sequence of operation, the unit is fully interlocked, and the two elements of the double breaker are interlocked to prevent simultaneous closing.

For bus-bar coupling the interlock can be made inoperative by means of a padlocked switch. The isolating plugs are automatically screened when the breaker is isolated, and, if desired, a feeder earthing device can be fitted. The potential transformers are mounted in a separate tank, and they may be isolated in the same way as the circuit breaker, the lowering gear in this case consisting of a hand-operated worm winch. The line plugs are automatically screened so that the transformer can be inspected without opening the circuit breaker, and the current transformers can either be immersed in oil or be embedded in compound. All the insulation, which must have good mechanical strength, is composed of bakelite, whilst the top plate of the breaker is a heavily ribbed steel casting to which the cylindrical steel tank is bolted by means of heavy steel down rods which fit closely to the tank.

A section of one of these armour-clad compound-filled circuit breakers is shown in Fig. 497. The unit is supported on two cast iron pedestals. The duplicate sets of bus-bars—which are shown at A and B—make connection with the duplicate oil-immersed circuit breaker through self-aligning plugs and sockets C, which are bushed in bakelite insulators. The top steel plate O and tank P are carried on lifting blocks, which are operated by a vertical lifting screw on each pedestal. A reversible electric motor drives the lifting gear. Blocks D and F form a fitment for the self-aligning finger contacts G, H and I. The bakelised moving contact bars are shown at K and M. Each of the two circuit breakers is provided with operating gear—as shown at N—and also with link mechanism and a solenoid. Switches of this type are made for 11,000 volts and 2000 ampères, 22,000 volts and 900 ampères, and 33,000 volts and 750 ampères.

The outdoor 600-ampère 135,000-volt three-phase automatic circuit breaker—shown in Fig. 499—is another of this firm's exhibits. The breaker has been designed mainly to meet the demands of the company's Australian and Canadian customers, for there is no demand for breakers of this type in this country at the present time. It will be noted that each pole of the breaker is a self-contained floor mounted unit, the units being interconnected by the driving mechanism, which is joined up to a manually-operated or electrically-operated device, mounted on the floor adjacent to the last unit. The breaker has been designed for heavy power systems, and has a rupturing capacity of 750,000 kilovolt-ampères. It is fitted with a special form of arcing contact giving rapid acceleration and operating under a large head of oil. Another feature is the all steel enclosure, which is capable of resisting high internal pressures and has a large expansion chamber and baffle vent for the arc gases, and an oil and gas chamber.





FIGS. 496 AND 497—ARMOUR-CLAD SWITCHGEAR—FERGUSON, PAILIN

Porcelain shrouded bakelite condenser bushing terminals accommodate ring-type current transformers for automatic operation.

In high-voltage apparatus the terminal bushing is, of course, a very important matter, and the design of the bushings used on these circuit breakers has received very careful attention. The bushings used—see Fig. 500—are built on the well-known condenser principle, with alternate layers of tinfoil and bakelised paper wound concentically, and the bushing is proportional, so that approximately equal voltage stress exists between successive layers, so that no portion of the insulating material has to withstand an electrostatic pressure exceeding the safe limit of the material. Moreover, by stepping the tinfoil layers a uniform voltage gradient is obtained along the axial length of the bushing. The upper ends of the bushings are protected by a series of porcelain petticoat insulators, which are cemented together, and the space between the insulators and the condenser bushing is filled with plastic compound. Ample space is provided to allow the compound to flow freely and to exclude air pockets. Plastic compound is used in order to insure a homogeneous mass, as varintions in temperature are apt to introduce cracks and air spaces in hard compound in consequence of expansion and contraction.

The lower end of the bushing, which carries the switch contacts has a porcelain shield, which prevents the carbonised sediment usually present in the oil from settling on the condenser layers. The static field from the terminal bushing tends to attract any dirt particles, and the porcelain shield prevents them being lodged on the surface of the bushing. The bottom of the sleeve is sealed so that there is no possibility of the arc gases getting through to the condenser steps whilst the top is fitted with gauze to insure that only clean oil comes into contact with it.

The flange, which is used for fixing the terminal bushing to the base casting is composed of non-magnetic material, to allow a ring current transformer to be stepped over and fixed to the underside of the base casting. The complete bushing with stationary contacts can be withdrawn without in any way disturbing the bushing transformer and its connections or the moving contacts.

The current transformers can also be removed without disturbing any of the switch contacts. A registration device on the terminal fixing flange ensures the correct location of the fixed contacts relatively to the moving contacts. At their lower end the porcelain rain shields are supported by a flange fitting, which enables them to be detached in bulk from the rest of the bushing. The flange supporting the bushing is electrically connected to the binding wire forming the outer condenser layer, the latter

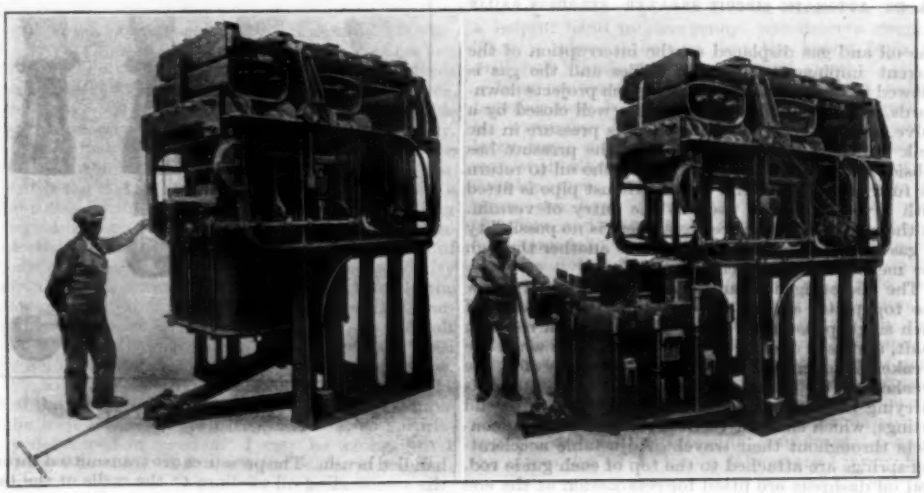


FIG. 498—ARMOUR-CLAD SWITCHGEAR—FERGUSON, PAILIN

being carried down below oil level. All the exposed surface of the bushing is therefore at earth potential; consequently, no corona or static discharge can take place in the air space above the oil, this being essential in order to prevent danger from the explosion of the gases which may collect. It will be noticed that the exposed part of the bushing is exceptionally long, and is suitable for use in countries where heavy snow may be expected. The condenser type terminal bushing has proved exceptionally successful in operation, and has the advantage that a small diameter and therefore powerful bushing type current transformer can be utilised for overload tripping.

An interior view of the breaker is shown in Fig. 501. The moving contact consists of a circular bakelised contact bar, with inverted V shaped ends, which engage with the finger contacts. This is carried on two solid bakelite rods, which are fitted with double flanges on each side to increase the leakage surface. The stationary contacts and the ends of the moving contact are enclosed in metal shields in order to reduce the electro-static stress which would otherwise be excessive on the sharp corners of the contacts. The top plate of the breaker is of cast steel and supports the terminal bushings and the operating mechanism, so that all are aligned from surfaces on a single unit. It is provided with a manhole, so that when the oil is removed from the tank a man can enter and carry out inspection or repairs. The dome top forms an expansion chamber to cushion the pressure produced on the interruption of large currents. Baffled vents are provided with an oil and gas separator, which prevents the possibility of oil throwing.

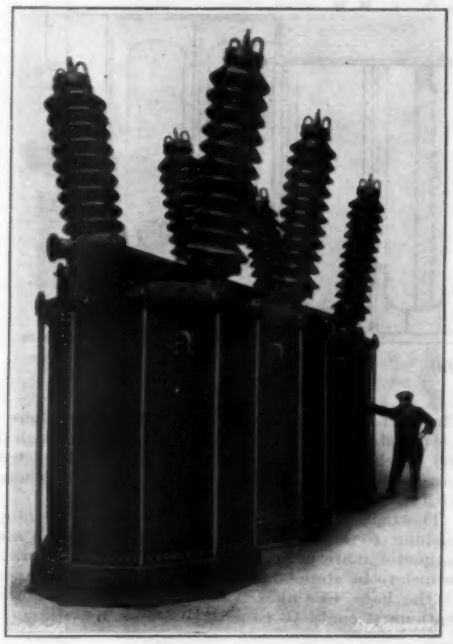
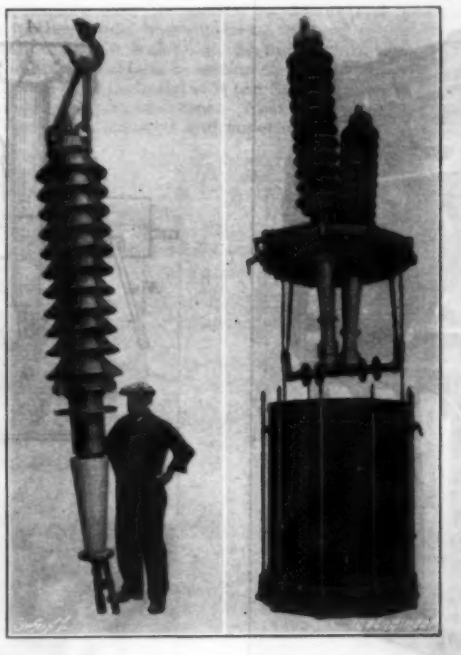


FIG. 499—AUTOMATIC CIRCUIT BREAKER—FERGUSON, PAILIN

The oil and gas displaced on the interruption of the current impinge against the baffles and the gas is allowed to escape to a vent pipe, which projects downwards, whilst the oil is trapped in a well closed by a valve, so arranged that while there is pressure in the tank the oil is retained; but after the pressure has subsided the valve opens and allows the oil to return for further use. The end of the exhaust pipe is fitted with a wire gauze to prevent the entry of vermin. In the case of multiple breakers, there is no possibility of gas being passed from one tank to another through the mechanism chamber.

The operating mechanism is accommodated below the top plate, and is self-contained in the case of each single-phase unit. It works through a rotating shaft, and as it does not displace oil and air when the breaker is opening, there is no tendency for the breaker to be blown in again. The bakelite rods carrying the moving contacts are provided with end fittings, which slide on vertical rods guiding the contacts throughout their travel. Adjustable accelerating springs are attached to the top of each guide rod, and oil dashpots are fitted for retardation at the end of the stroke. The moving contacts can be withdrawn through the manhole if repairs are necessary.

The length of travel and the wide spacing of the moving contacts on super-tension breakers necessitates the use of heavy moving parts, which are very difficult to accelerate, and as a high rate of contact separation is imperative in order to reduce arc duration to a minimum, it has been necessary to embody a special form of quick break attachment. The arcing contacts separate at a much higher velocity than the main contacts. This is accomplished by an ingenious arrangement, whereby at the instant of interruption, one arcing contact travels upwards and the other downwards. In the opening operation the main contacts separate first and a latch holds the two arcing contacts together, the upper one being pulled down, thus compressing a spring-loaded telescope, until the moving contact has dropped approximately 8½in. The latch is then released and the spring retrieves the upper arcing contacts. Fig. 502 indicates the arcing contacts about to separate. The arc actually takes place well away from the main contact, and a clear path is ensured for the upward movement of the gases. The magnetic effect of the current passing down one stationary contact across the moving member and back through the other stationary contact deflects the arc away from the contact and towards the side of the tank. The arcing contacts have a large thermal capacity, and are of the plug and socket type, whilst the main contacts are of the



FIGS. 500 AND 501

finger and wedge type. Holes are provided in the bottom of the corona shields on the moving contacts, to allow clean oil to be forced up to the arcing contacts on opening.

The cylindrical tanks are 5ft. 3in. in diameter, with spherical bases, and are made of heavy boiler plate. They will withstand a pressure of 250 lb. per square inch, and are rigidly held between the heavy steel cradle and the top plate by means of ten 1½in. diameter steel bolts. A gasket is fitted between the tank and the top plate to prevent oil throwing. The cradle serves as a floor mounting pedestal for the tank, and holes are provided in the rim so that the bottom of the tank can be painted with a long-

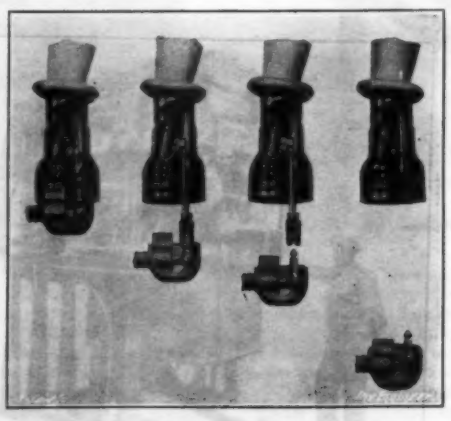


FIG. 502—ARCING CONTACTS

handled brush. The pressures are transmitted through the surrounding oil medium to the walls of the tank, and the interrupting capacity of the breaker is very largely influenced by the ability of the tank to withstand these pressures. Past experience has shown the danger involved in trying to confine the arc to too small a vessel. The tanks are provided with means for draining off the oil, and have fittings for filling and maintaining the proper oil level. They are provided with insulating linings built up of several thicknesses of insulating material, the maximum insulation being provided at the part nearest the arcing tips.

For automatic operation bushing type current transformers are desirable on account of their small cost compared with separate multi-turn transformers. With the usual designs of breakers, however, there is a definite minimum primary current tripping value possible. With this type of transformer, this current is approximately 94 ampères when using two bushing transformers in series. A marked improvement on this minimum tripping value is afforded by the incorporation of the firm's patented super-sensitive tripping device, which enables the current to be cut down to less than half the above value. This means that even on low-current circuits overload protection may be provided by using bushing type transformers operating on alternating trip coils without the use of relays or auxiliary tripping supplies.

To facilitate inspection of the breaker contacts without removing the oil, a periscope arrangement can be supplied with reflecting mirrors at the lower end. An incandescent lamp illuminates the contacts or other parts through the intervening oil medium. A typical breaker as described has successfully withstood a pressure of 300,000 virtual volts at a periodicity of 60 cycles for one minute applied between the terminals. The weight of a three-phase breaker complete with oil and solenoid operating gear is approximately 22 tons, and the oil required is 2400 gallons. The weight of one condenser bushing complete is nearly half a ton.

The Failure of Intensified Research Work in England.

By JOHN G. A. RHODIN, F.I.C.

In whatever direction we look, we see that manufacturers have launched out in research work with a view towards improvement of the old and creation of new issues. I had no idea of the magnitude of the efforts till just lately, when I spent some six months as a unit in a huge research machine brought into being by the war. Now, in spite of the existence of these machines we hear complaints from all quarters about the smallness of the results of these efforts. My late experience has given me a certain idea about the causes of this disappointment, and I shall in the following article attempt to outline the defects most apparent to my mind.

As the first and most important mistake, I shall put the lack of consideration for the national bent of the individual Englishman. The research institutions have been transplanted from the Continent bodily, method and all. Now, the first principle in German laboratories is to distrust the bulk of the staff, and to trust a very small number only. However ugly this may sound, it is a fact, and, what is more deplorable still, is that this same plan is being attempted in England at the present moment. *Divide et impera* is the rule, and men are put to work out details without any knowledge of the reason why. Now the fundamental characteristic of the English mentality, as of us Scandinavians, is a demand for full and complete trust. We both get it from the professors at college, in our home, and amongst our friends. Is it likely that a high-spirited young man will knuckle under to do, say, the analytical work on by-products emanating from another department from a process or processes unknown, and will keep doing so for years as his German *confrère* does? He will simply get "fed up," lose interest and probably miss opportunities of making discoveries put under his nose every day. The better man he is, the sooner he will give it up, and look out for a better job. The thirst for retaliation and promotion which causes a German to make discoveries under such circumstances is altogether foreign to an English mind. To discover the best Englishman, I have always found it the most successful plan to let him tackle something beyond the scope of his experience, and to watch his mode of proceeding. If he has it in him, he will find a way of getting there; if not, then you may put him to unimportant routine work. Then he may find himself, and work back to the higher level.

Following up this mode of reasoning, we ultimately arrive at the conclusion that large research organisations are unsuitable *per se* for this country, where progress so far has been made by individual effort. In some directions, notably the chemistry of colouring matters and organic chemistry in general, numbers may tell, but I consider even that doubtful. Germany itself, in spite of the great number of its workers, has probably no more great names to point to in science to-day than has Great Britain, if as many. The bulk of, for instance, *Zeitschrift für Physikalische Chemie*, consists of accounts of mensurations of physical constants without any separate interest whatsoever. The few exceptions for, say, one year might be reviewed in one article of moderate length in The Engineer. *Berichte* is similar, though from an economical point of view some of the discoveries might be valuable. But there, again, people in the street exaggerate the value of the one chemical trade in which Germany leads, viz., dye manufacture, production of artificial remedies, and the making of fine chemicals. The sums involved would not affect the political economy of Great Britain to any appreciable extent. That the existence of the factories is of great importance in the case of war is another matter, but to found a similar industry on new British discoveries is a somewhat tall order. Such seems, however, to be the intention of the intensified research in organic chemistry, and that is another cause of failure. It is not below the dignity of any nation to

take up an existing process and improve upon it. That has been done to some extent here, but so far every chemist and physicist prefers the German product, if procurable, even if the price is higher than that of the English article. The word "research" means searching over again, and applies to finding out how good products are made, just as much as to attempting new discoveries. Now, it is a fact that, in spite of research committees and all, you cannot get a piece of "soft" glass tubing of English make which equals the German pre-war article. I say "pre-war" advisedly, as our friends over there seem to have lost the art to some extent themselves. Soft glass is the research chemist's first requisite, and it is not even yet available. In this case the failure is comparative and not absolute, as the glass produced is workable, sometimes easily so. But the most easily workable glass is brittle, and it is positively dangerous to fit tubing made from it through a perforated rubber stopper. In other cases it cracks on its own account in well made and annealed joints, &c. Now, the men responsible for the scientific groundwork are beyond all doubt as capable men as there are to be found in the world, but are the glass workers the same? To that question I can unhesitatingly answer, No. Most of them have been working in pressed glass, lead glass or anything else than glass free from lead for working with the lamp. They think that they know all about it, and it is probable that the research men's methods are modified by the workmen unconsciously. I do not even bar wilful modifications, which I have heard men in the chemical trade actually boast about.

Chemists.

There seems to be a spreading feeling of contempt for chemists in particular, amongst the working classes. This contempt is most noticeable in districts where chemical industries are new, and where the workmen do not like what they call interference. Time only will cure that source of delay in fresh developments, as I can assure the reader that introducing German methods of discipline would lead to inevitable disaster. As an illustration, take the prohibition of smoking in a factory. When the writer first started in a Lancashire factory some thirty years ago, you never saw a notice prohibiting smoking in a chemical factory, and you never saw a workman attempt to smoke during working hours. They were just as happy without, because "you never miss what you have never had." The war altered all that, and now it is impossible to suppress surreptitious smoking even in actually dangerous factories, in spite of numberless notices threatening instant dismissal. This by way of an illustration of the psychology of an Englishman, which renders the transplanting of foreign methods useless. It will take years to make men see the dangers to themselves which nearly all new processes involve, and the absolute necessity for strioter discipline. This statement requires some further explanation, but it is a fact that most new things are associated with extremes of temperature, pressure, electric tension, inflammability, explosiveness, &c. &c. There is no more effective cause of preventing the continuation of a promising research than a serious accident. Even minor accidents affect the decision of an English management, if they might have been serious. Whether the cause lies in legislation or humanity, or in both, is difficult to say, as timidity or "funk" is certainly out of the question. Anyway, the frequency of accidents during research work has increased greatly with deterrent effects. These psychological and temperamental causes which militate against "massed" research work are too many to be enumerated and discussed here. The remedy lies in improved secondary education on standard lines similar to those adopted in the Scandinavian countries. A mere matriculation examination is insufficient; there must be years of solid work behind it. I know that a great deal of prejudice exists against this course as wasteful and tyrannical, but I think that you learn more about useful discipline by the simultaneous mental and bodily training at school than even in the most up-to-date army. And concerted action presupposes "self-inflicted" discipline, where research is concerned. This does not necessarily mean self-negation, as in the countries mentioned the results of individual effort are just as much in evidence as here.

Education.

There are, of course, many different opinions about the objects of secondary education, most parents all over the world leaning towards the belief that the production of infant prodigies is the main thing. In Sweden, and I believe in the other Scandinavian countries as well, the professed object is a systematic, gradual ripening of a young man's (or woman's) faculties towards a common standard of maturity. Hence, the time of study is made longer than in most other countries—normally nine years—and the starting age is fixed at nine years or more. This in itself is against English conceptions, but I have observed that the idea is gaining ground lately. To pass the actual final Swedish maturity examination does not require the time, which is to a great extent used for training power of observation, bodily fitness, power of intelligent speech, quickness in drawing correct conclusions, &c. &c. The young "person" at eighteen, under normal conditions, is supposed to be capable of taking care of himself at the University, technical high school, in the Civil Service, &c. &c., without any special examination. Whether this time for a start is too late or too early, I leave to others to adjudge, but from my own experience of university students in both countries, I believe that the English student goes to them to pass examinations and his Swedish counterpart to learn something useful.

I mentioned that particular attention is paid to the training of the power of observation, and I may say that the start is made with natural history, studied both in the field and in the class-room. It is continued right through all the various classes up to the top, and the collection of botanical specimens during the summer vacation was in my time almost compulsory. Determination of unknown species with the aid of the "Standard Flora Scandinavia" (unillustrated) was taught at once. The enormous benefit derived later from an early acquaintance with co-ordination of characteristics, fixing the method in the mind unconsciously, is naturally invaluable. Weeds have thus their uses, and I can assure the reader that I personally learnt more from them about systematic investigations than from the few miserable experiments in the school laboratories. To cite an instance, the determination of the species, sub-species, &c., of a hybridising gender like Rubus (brambles) requires observation of marked plants during four periods of the year. Naturally only boys with special interest in the subject would take up difficult subjects like these. As a curiosity, I may mention that in my time nineteen distinct species of Rubus were found in Sweden, apart from hybrids, most of them almost indistinguishable by single observation. There seemed to be a curious fascination about both botany and zoology to most of the boys, and the school museum, which was started in my time, bears witness to our efforts to this day, and—this is the point—not more than one of my class-mates ever used the knowledge thus gained in after life, and he is a forest-master in the North somewhere. The subject is taught for training the power of observation as being the least costly one, besides offering more variety ready to hand than the school laboratories, which came later on.

How the subject could be used in England, where most of the wild flora and fauna are beyond the reach of all but a few, is another matter. Cultivated, sexless plants are of no value for teaching botany, and botanical gardens are few and far between. The study of zoology is a far easier matter, even London itself possessing quite a rich wild fauna, but probably efforts in that line would lead to extermination of most living things. I have often wondered what substitute could be found to "open the ball" of scientific study, which involves observation and deduction, acquaintance with a logical system, differentiation between essentials and accidentals, &c., without being above the grasp of a youngster nor below the dignity of the more mature—like natural history.

Botany was, and probably still is, the national science in Sweden, giving useful training and a healthy pastime to most. In all probability the thus sharpened power of observation of small things has reacted on the bent of the research workers over there. To give an example, while the knowledge of the rare earths was in its infancy, when minute chemical differences split up the, to all appearances, similar things—or, say, identical ones—into different elements, the bulk of the work was done by Swedish investigators, to mention only Berzelius and Mosander, who have thorium, zirconium, cerium, lantharium and didymium (of the time) to their credit between them. Everybody knows about Berzelius; hence, I shall give an example, of Mosander's remarkable power of observation, coupled with subtle ingenuity. In 1842 he put his discovery of didymium before the meeting of the Scandinavian scientists in Stockholm. Towards the end of his paper he says: "I noticed a great difficulty in getting constant value for the water of crystallisation of the sulphate . . . and I conclude that the earth is probably made up of two of widely differing atomic weight." It was only fifty years after (approximately) that Welsbach made the separation! I want to remind the reader that constancy of water of crystallisation is always difficult to obtain, and that Mosander must hence have been very confident in himself to venture the suggestion. L. F. Nilsson's discovery of scandium without the aid of the spectroscope in our time is another example of the wide-awake power of observation, so surprisingly developed in Sweden. I may be wrong, but I am forced to think that the main factor is the universal study of natural history from the earliest stages in the Swedish public schools, old and modern.

An Englishman is very often much more ready with spontaneous conception of new ideas than my race, but in research the *a posteriori* conclusion is generally more valuable, if based on seemingly trifling observation. Intellectually, I believe that all the Nordic races are about alike, and I should like to see the English race have the advantages which have made the Scandinavian produce more discoveries than their numbers warrant. The facilities for higher education are as good here as anywhere, but on the secondary elementary stage there is a lack of understanding the difference between pedagogically useful studies for training senses and mind together, before attempting highly abstract subjects.

I have pointed out the study of living things as a good starting point, which has never been attempted here. Engineers may think such a course waste of time, but I know that a knowledge cannot be imparted to a non-understanding mind with regard to the concrete world leading on to the abstractions by the process which the word indicates. An exception is the use of figures, reading and writing, which are everywhere taught at a still earlier period. On the secondary stage, however, the progress should be made *vid* practical geometry side by side with theory. The issues on these subjects do not differ very materially in different countries, though, on account of the long time available, the modern Swedish maturity examination on the scientific line demands a minimum knowledge of analytical geometry in excess of anything that could possibly be attempted here.

Physical Training.

In one way we envy the English their lack of necessity for knowing foreign languages in most walks of life. To-day the bulk of Swedish students cannot write their own language with academic purity, and for the "maturity" they can translate from the French instead! I shall leave mention of the overdone study of humaniana, including history and geography, logic, anthropology, national laws, &c., and turn to the second redeeming feature, physical training as a means to self discipline and self control. Anybody who believes that this is a terrible punishment to the young is greatly mistaken. The gymnastic lesson is looked forward to by almost all, and you see only smiling faces in the drill hall. It is just there where lifelong friendships are made under the auspices of the best liked master, who is the friend of every boy in the school. The Ling system of pedagogic gymnastics condemns straining the young body to fatigue, and the progress is so gradual that the pupils do not even know that they are improving in physique. Periods of rest are given according to age and efficiency, and all "showing off" is strictly kept down to allow evenness of performance to be obtained. Accidents are practically unknown—I only saw one in fourteen years—and the spirit of collaboration in a friendly manner soon makes the strong help the weak without being asked. After four or five years' drill you could yourself observe the improvement in physique, temper and readiness to work together in everybody. In the four upper classes—gymnasium—you became vastly better gymnasts than the teams seen at the Olympic sports, who are chosen from clubs, as it is considered unfair to compete with teams trained so long together at the schools. What, however, sticks to you for life is power of endurance, and desire for voluntary collaboration. The initiatory gain to the nation may be considerable, but a far more important one is the power of sub-ordination without losing the feeling of equality, which is so necessary in a body of men, working out an important research together, be it in pure science, engineering, civil organisation or anything else. That peculiar notion of men, who know their inferiority, refusing their help on the plea, "I am as good as you are," is unfortunately one of the most effective deterrents to efficient research in this country, particularly of late. Curiously enough the actual superior or equal is always willing. The feeling of equality of personal worth is an honourable one, even if you do not possess it; but if you make it an excuse for refusing a helpful hand in emergency, you deserve flogging. That is where I believe that the lesson from the drill hall stands anybody in good stead.

How serious this absence of willingness to pull together may be, I shall endeavour to illustrate by an example. Let us suppose a large chemical laboratory, erected during the war, has taken in men with allowance for the then ruling scarcity of suitable men. After the continental fashion the stores are kept outside the control of the chief chemists, and managed by a pharmaceutical chemist accustomed to hand out goods. As a proposition there is nothing wrong in that, especially on the Continent, where the apothecary, as a rule, is a university man. But continue the supposition, let this man here stand on his dignity as the only "chemist" by Act of Parliament and fall out with everybody, making it a three months' job to get a few feet of rubber tubing? What will happen? Well, the research man will have to get his own or wait. Such things and worse, unfortunately, do happen, and the enterprising firm loses. Leaving the stores, let us go into a laboratory room. Here we find a young man, with B.Sc., A.I.C., attached to his name, but backed up by no experience, working side by side with an experienced man in the line without these advantages. Experience sees B.Sc., &c., make a serious mistake and gives advice. "Mind your own business," follows. The older man retires. Now, such an incident is quite common, as most laboratory chiefs know, and the loss of time is deplorable. I reiterate that the only safe remedy is a common standard secondary education of such duration as to make the man familiar with the common ethics of life, amongst which respect for seniority on the subject in hand is one of the rudiments.

Observation.

With regard to my belief that training power of of observation and deduction is somewhat neglected,

HIGH-SPEED WIRE ROPE-MAKING MACHINERY

THOMAS LARMUTH AND CO., LIMITED, MANCHESTER, ENGINEERS

(*For description see opposite page.*)

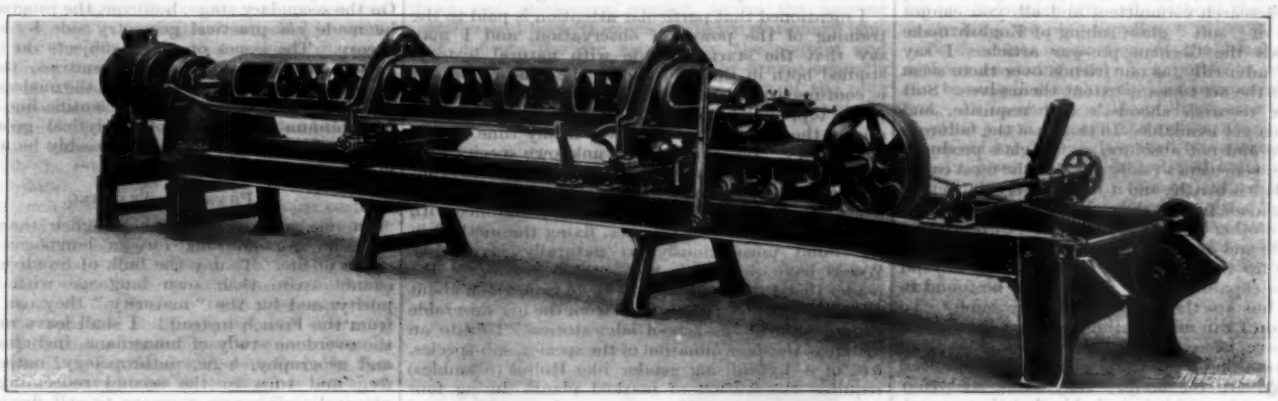


FIG. 100—SEVEN-BOBBIN, 6½-INCH DIAMETER, STRANDING MACHINE

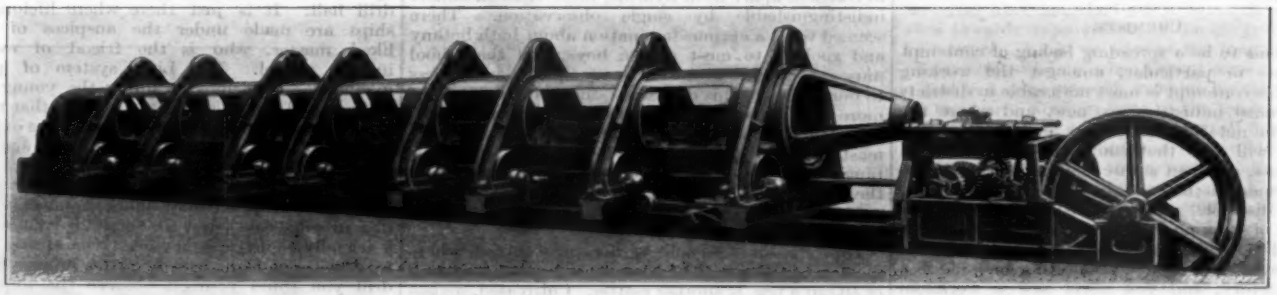


FIG. 101—EIGHT-BOBBIN, 24-INCH DIAMETER, CLOSING MACHINE

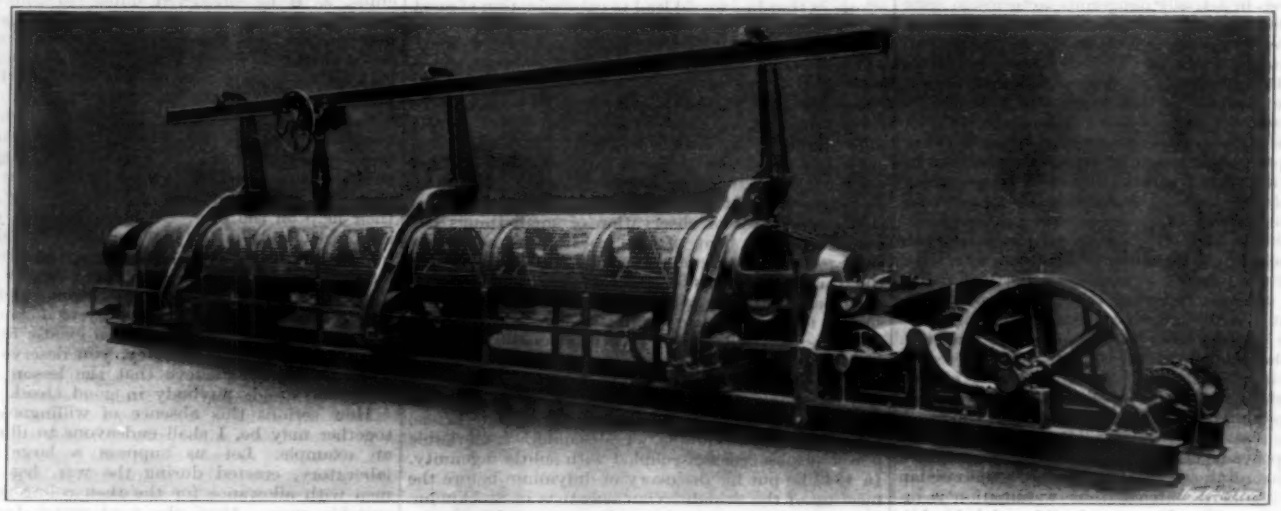


FIG. 102—SEVEN-BOBBIN STRANDING MACHINE WITH GUARDS AND LIFTING TROLLEY

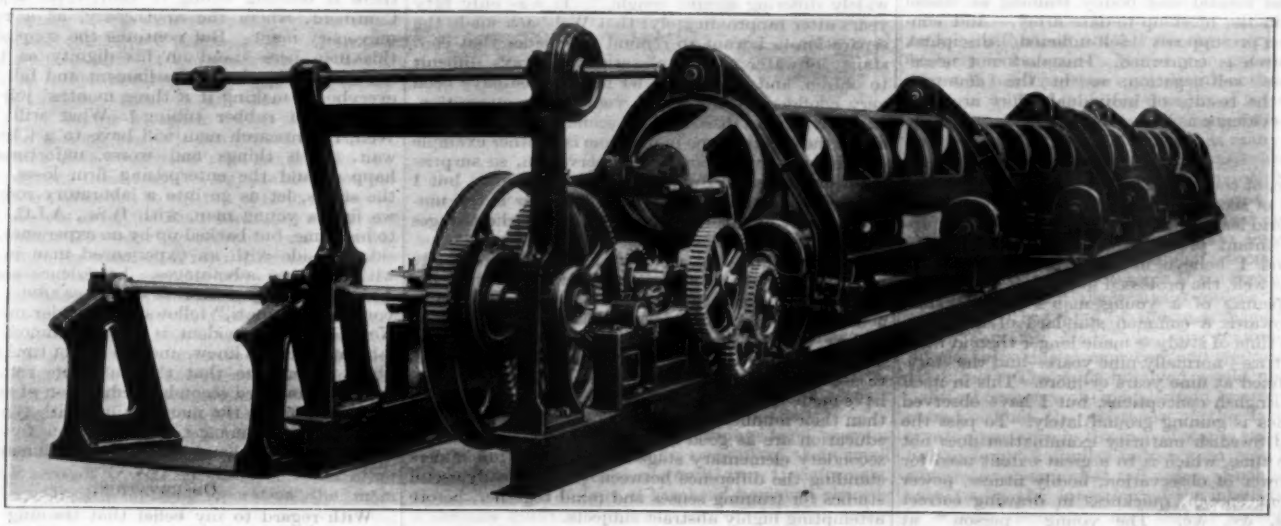


FIG. 103—EIGHTEEN-BOBBIN STRANDING MACHINE

I could give thousands of instances, but I shall confine myself to one which happened in my own laboratory not so very long ago. I put a man to take the evolution of heat during a certain reaction in an elaborate calorimeter, which was yet without a constant temperature mantle. The instruction was to observe the rise and fall of the temperature at equal time intervals. My man came after many hours to inform me that the thermometers would not fall. I told him to find the temperature of the room, and he told me that it was the same as that in the calorimeter, without losing his dejected look. That he had started with the calorimeter colder than the cooling medium, did not enter his head till he went and looked it up in a text-book as a "thing to be guarded against." He was a prize man who had specially studied physical chemistry in Germany! But, I reiterate, it is too late to start training the quickness of deduction from observation at the university or technical school, if the man is taking up research work immediately afterwards. Otherwise the "research man" only knows what Professor Henry E. Armstrong, in a recent address to the London section of the Institute of Chemistry, calls "an indefensible jargon," which he cannot himself understand. The ability to see and to conclude is the main thing, and this is also helpful in looking through a *résumé* of the state of the art to find a subject to begin to work on. But here again we come back to the *cul-de-sac* leading to the fact that research must be done by one individual—with helpers or colleagues, if you like, to avoid the word assistant. A research laboratory should have the motto: *E pluribus unum*, like the United States, and, unlike that Republic, act as one.

Research.

If we now tabulate the various points discussed, they are:—

Difficulties.

(1) Through uncritical transplantation of foreign methods into this country.

(*a*) Through temperamental causes.

(*b*) Through absence of uniform secondary education.

Consideration of all the points brings us back to the inevitable, viz., successful collective research is a matter for select individuals possessing the necessary faculties for getting followers or forming schools. I made the excursion into Sweden to give the causes, why cordial collaboration is possible there, with the reservation that so far progress has been made there as here by individual effort. What is more, on close consideration, we find the same to apply to Germany as well, where all these institutions only work out ideas submitted from the outside, or take on a man who has some idea to work out, as the case may be. Then comes the question of what use large research laboratories may be to an individual works. From what I have seen they gradually become mainly more or less inefficient routine laboratories with one or two research workers serving as embellishments rather than as useful adjuncts. When the war was on, research was invited on certain subjects by the Government, *e.g.*, the outside, and research was carried out with some success, a contributory factor being the higher rate of pay which attracted good men to it.

The economical side of the subject is also of first-class importance, and we may ascribe a lot of the inefficiency to the trade depression and the general feeling of insecurity. Firms cannot pay what is called non-productive labour, and they get what they ask for, when they stretch a point in that direction. I am not paying attention to chemists only, but to scientists and engineers as well, there being no marked lines of distinction in these days. With regard to the word "chemist," I shall beg the indulgence of the reader, if I add another remark to the controversy. I think that analytical chemistry is merely a skilled trade, quite on par with that of Professor Armstrong's "pill-roller." The less an analyst bothers about the science of chemistry the more likely is he to become an accurate machine. If he is a man of science, when he starts, he will sooner or later cease to be one, when he has carried on his soul-murdering routine for years. This by the way, and I will only add that trade depression has affected that professional trade as adversely as the rest.

Now to return to one of the points raised in the beginning of this article, the striving to make absolutely new departures. I have seen a gentleman of high qualifications devoting all his time to working out an economical synthesis of acetic acid from the elements. Regardless of cost, it has been done before, but to do it economically is a tall order. Secondly, what would be the national gain if the object were achieved? Acetic acid is not dear because the raw materials are expensive or the cost of production high, but on account of the normally fairly small market which limits the scale of production and raises the overhead charges out of all proportion. Furthermore, the synthesis must be expensive in the best of cases, involving, as it does, combination between carbon, hydrogen and oxygen, the hydrogen being divided between the other two. If it were cheap anybody would stop at the hydrocarbons, which, of course, have a vastly greater market. This in itself is not attractive, because the artificial carbide costs many times more than natural hydrocarbons at present, and the raw material of acetic acid, waste wood, belongs to the same category. Other departures like nitrogen condensation, &c., where cheap power is a *sine quâ non*, are out of the question, unless easily obtainable water power is available. Where success is feasible, as in the case of vat dyes from anthraquinone, a great deal has been achieved in small laboratories attached to moderately sized works. Thus the natural process of progress is still going on, as it always will.

Now comes the question, how do these great laboratories in Germany manage things so well, although attached to works? Simply because they do not exist in the concrete; only the chemists do, and even when working under the same roof each specialist with his satellites forms a separate entity, which has been brought there to meet an existing emergency. Here the men are brought together to create both emergency and remedy. The undertaking has had no natural growth, being either a war mushroom or a merger of interests, or an undertaking started on an enormous scale to work processes which have not been worked successfully on a small scale to begin with. Scientists are asked to find out something to make money, save money, and simultaneously to be new and startling, all at a moment's notice. They are told not to bother about arranging for means to carry out the work—it is all there—the latest from Paris, New York, Berlin, or anywhere else. Above all, they must make reports, there are so many that all and sundry must make reports. They must ask for one kind of requirement on a green form, another on a red one, and when the colours are exhausted there are stars and stripes, as on the ensign of the country from which all this is imported. They try all this, they do some decent work even, but they bear nothing decisive; they try again with the same effect, and finally they get exhausted. If they can still keep on making reports on questionable data they can go on for ever like Tennyson's brook; if not, they must seek pastures new or break down utterly. Such is "intensified" research on a large scale, and the public wonder why it leads to so little. The answer is simply that in a large research laboratory of the kind under discussion it is nobody's interest to be successful.

If we look at pure science the picture is more cheerful. England is the leading country in the development of radiology, with its remarkable consequences; but, as usual, through individual efforts. The names of men like J. J. Thomson, Bragg, Rutherford, Soddy, &c., will live in spite of Nobel prizes. Their discoveries and their ingenious explanations of the facts are the outstanding features of the latest in science. The only foreign name to be coupled with theirs is that of Rydberg, the original discoverer of the mathematical relationship between spectrum and atomic weight.

Engineers and Research.

In engineering, research has achieved great things, mostly in improving designs and details and standardisation of parts in motor traction and aviation. Even here everything seems to have a *nomen proprium* attached to it or the style of a particular firm. How much or how little has been done by various committees it seems to be difficult to say. The improvements of materials have gone on, but I fear the day when alloy steels will be cheap enough for shipbuilding and structural purposes is far off as yet. With regard to official specifications for, say, aeroplane parts, these were well put together, paying due heed to, for instance, the difficulty of getting chromium, during the war. On the other hand, certain official recommendations on alloys were utterly unpractical. I have observed, however, that engineers make good collaborators as a general rule. Collective work amongst English engineers is also of long standing, as we can see from the age of the institutions. The most marvellous example of collective work in the world leading to unequalled standardisation is presented in the cotton trade in Lancashire and the adjoining parts of Yorkshire. From what I have seen in my own line of metallurgy and foundry work, both in America and here, I not only think, but I know that British working engineers are more efficient in that business at least than their American counterparts. To let the perpetual vituperation of the working engineers go unchallenged is hence a regrettable thing, which ought to be rectified. Research in engineering has been continuously successful here, mostly because every decent man in a shop takes an interest in making an experiment a success. There are admittedly black sheep everywhere who foster disturbances, but they will eventually be eliminated as times become normal. The researches carried out at an engineering works hardly ever become public knowledge; to get the article one wants is looked upon as a matter of course; how it came into being is another thing. This silent progress is the strength of this country, but it is unknown abroad. To give an illustration and to pay a compliment to my adopted country I shall relate an actual occurrence. Towards the end of the war the Swedish Government sent over a commercial attaché, an eminent engineer. I, in company with our general manager, who gave the permission, took him to our works and showed him our die foundries, and explained how the work was controlled. When left alone with me in my office this gentleman said: "I never expected to see anything like this in England. In confidence I may say that I expected something like it in the best places in Germany, but I never saw it." An American specialist, who saw it also, simply substituted America for Germany.

British Wire-drawing and Wire-working Machinery.

No. XIII.—HIGH-SPEED STRANDING MACHINES.*

In the preceding article of this series there was described a set of machines for making electric cables, in which what is known as the "bar" type of stranding machine took a prominent place. These machines are used quite extensively in both the cable and wire rope trades. There is, however, another distinct form of stranding and laying-up machine of great merit, several examples of which are illustrated by the engravings on page 432. They are made by Thomas Larmuth and Co., Limited, of Todleben Ironworks, Unwin-street, Cross-lane, Salford, Manchester, and are manufactured, under licence, on the Continent by Krupps.

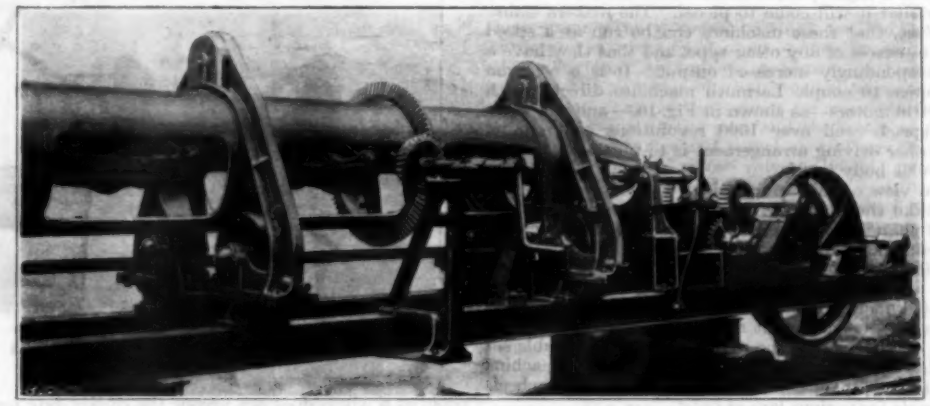


FIG. 104—HAND TURNING GEAR

The broad principle employed is the same as that of machines already described, but the Larmuth machine is distinguished by the fact that the main body is not built up of rods and discs bolted together. Instead, it is formed out of a mild steel tube turned up outside, bored through from end to end, and provided with a number of openings or windows to give access to the bobbins. There are three openings round the circumference opposite each bobbin, and the number along the length of the tube naturally depends upon the number of bobbins.

The weight of the tube is carried by a series of rollers mounted in brackets, which can be slid transversely on cross stretcher frames, so that they can be adjusted to share the load evenly without distorting the tube. At each stretcher there is also a hood bracket reaching over the top of the tube and carrying a third roller. Finally, at the back end of the machine there is a mild steel shaft, bolted to the cast iron end of the tubular body, which runs in a gun-metal bearing.

The bobbin cradles are boat-shaped iron castings, and the trunnions run in standard ball bearings. The front trunnion is bored out with a large hole and bell-mouthed, so as to give a fair lead for the wire coming from the bobbin. The bearings are carried by three-legged brackets, which are riveted to the shell of the tubular body, and can be plainly seen in Fig. 100. The bobbins run on mild steel spindles held in place by means of a spring plate, which drops

* No. XII. appeared October 10th.

into a notch in the end of the spindle. It is consequently a simple matter to change the bobbins on reloading. A slight braking effect on the bobbin, to prevent it over-running, is produced by a cord lapped round a groove in one of its flanges, and tensioned by means of a hooked bolt on the side of the cradle. The smaller sizes of bobbin are made in one piece, from a malleable casting, but the larger sizes are built up with mild steel flanges and a hard wood barrel, with a cast iron core for the spindle, all held together by rivets running from end to end.

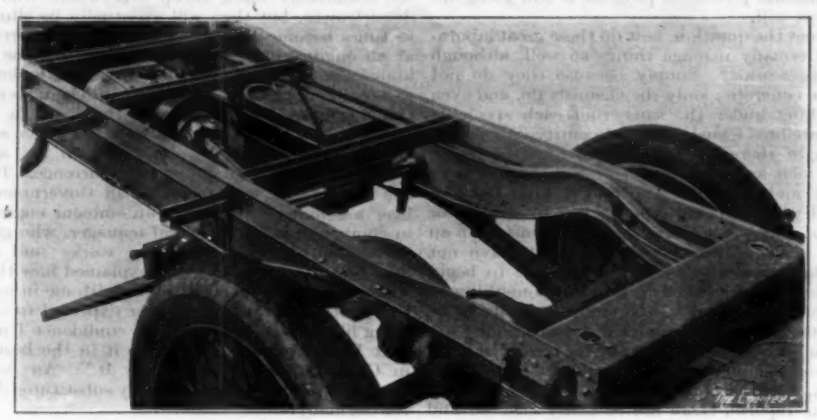


FIG. 1—DOUBLE FRAMEWORK OF DAIMLER CAR

Wire runners or fairleads are riveted inside the tube to guide the wires from the bobbins to the head, and between the runners there are grooved plates for the same purpose.

It will be readily appreciated that the whole arrangement forms a very substantial structure, which can be balanced with nicety, and consequently can be run at a high speed without vibration and with no fear that it will come to pieces. The makers claim, in fact, that these machines can be run at a speed far in excess of any other type, and that they have a correspondingly increased output. It is a common practice to couple Larmuth machines directly with electric motors—as shown in Fig. 100—and run them at speeds well over 1000 revolutions per minute. Another driving arrangement is to put a belt on the tubular body itself.

In view of this arrangement, it becomes necessary to take the drive for the hauling-off gear from the end shaft of the main body, and a pinion is consequently keyed to the shaft between its two bearings. Inside the pedestal carrying these bearings there is a set of reduction gearing for driving the longitudinal shaft which works the hauling-off capstan. All the gearing is machine cut and runs in an oil bath. At the capstan end of the machine there is a double set of bevel wheels—see Fig. 101—to allow the machine to be run in either direction, while change wheels provide for various lays of twist.

The lay plate, fixed in the front head of the body, generally has hook-shaped openings for the wires—as shown in Fig. 102—which greatly facilitates stringing up the machine, but sometimes plain bell-mouths are adopted. This illustration also shows a light runway for helping in loading up the bobbins single-handed, and a set of wire guards as an added precaution against flying parts. The brake used to stop the machine can also be seen in Fig. 102, just behind the front roller head. It is intereconnected with the belt striking gear, so that the brake is put on as the belt is moved to the loose pulley.

The die box for the nips, or dies, is carried by two horizontal spindles fixed in brackets immediately in front of the lay plate, and can be adjusted along the spindles to suit different lengths of lay.

A very simple, but effective form of hand turning, or barring, gear for use when loading up the machine is illustrated in Fig. 104, but needs no description; while Fig. 103 represents an eighteen-bobbin stranding machine with the stand for the winding drum arranged alongside the draw-off capstan. In such a case the strand is run over a jockey pulley hung from the roof to guide it from the capstan to the drum.

While the tubular construction is unquestionably the best for moderate-sized bobbins, say, up to 28in. diameter, it becomes impracticable for larger sizes, and in the case of big laying-up machines, such as that illustrated by Figs. 105 and 106 on page 438, Messrs. Larmuth adopt the open type of construction. This machine has six 48in. bobbins and works in conjunction with a forty-eight-bobbin paper lapper and copper gear for making electric cables. It will be noticed taping that the cradles for the bobbins are built up of rolled steel joists with forged ends, but for slightly smaller bobbins the cradle is generally a single forging. The floating gear and general principle of the machine follow orthodox practice, and need not be enlarged upon here.

Motor Car Show at Olympia.

No. I.

The annual Exhibition of motor cars and accessories, organised by the Society of Motor Manufacturers and Traders, which opens to-day—Friday—is, for business reasons, being held about three weeks earlier than hitherto, the principal purpose of the advancement of the date being, we understand, to enable the large number of foreign and colonial visitors, who are at present in this country on a visit to Wembley, to view the most recent products of the British motor manufacturers. If for that reason alone the Society has acted wisely in holding the Show earlier than usual, but we shall be surprised if the trade as a whole does not favour the earlier date for all future exhibitions, as it will better enable manufacturers to prepare their programme for the coming year's trade. It is notorious that in the past many orders have been lost to the home motor industry on account of its failure to give delivery sufficiently early in the spring of the year when the pressure of orders is the heaviest.

FIG. 4—DAIMLER FINAL DRIVE

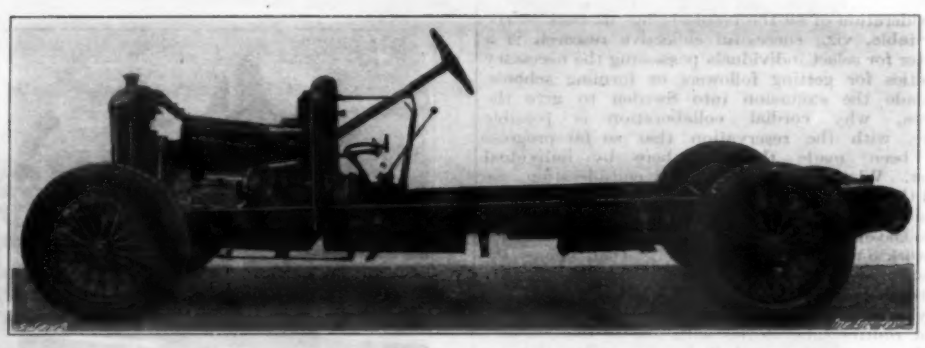


FIG. 2—CHASSIS OF DAIMLER CAR

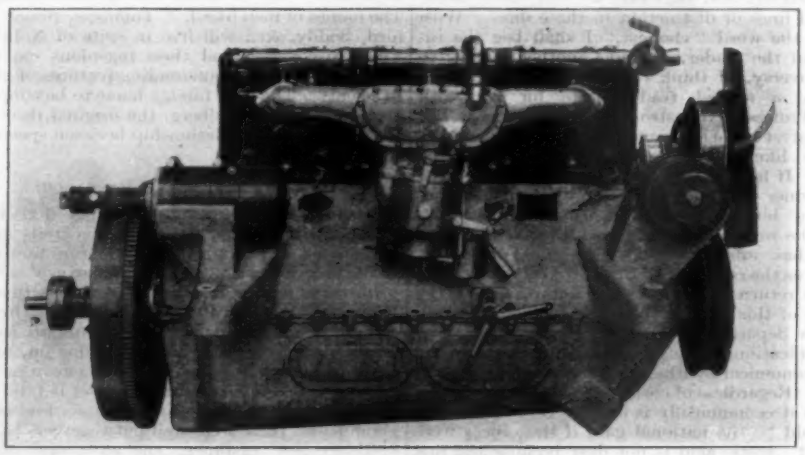


FIG. 3—CARBURETTER SIDE OF SIX-CYLINDER DAIMLER SLEEVE-VALVE ENGINE

In spite of the general industrial depression which has prevailed during the past year, the British motor car industry has been kept well employed, and it is estimated that over 200,000 cars have been sold in Great Britain alone. Notwithstanding this considerable output, representing a turnover of probably some £50,000,000, the industry as a whole is not in a very stable condition financially, and is deserving of all the encouragement that can be given to it by the purchasing public, if only on account of the employment which it provides. The industry is fully alive to the difficulties which lie ahead of it on account of the abandonment of the McKenna duties, and it is realised that foreign competition will be keener next year than it has ever been. As regards quality of workmanship, design and material, the British manufacturer is quite capable of "holding his own," nor can he be accused of "profiteering," for the prices of cars which rule to-day, all things considered, are remarkably moderate, and further reductions in prices are to come into force next year. It is, however, to be hoped in the interests of the industry as a whole that there will be no resort to "panicky" price-cutting.

The outstanding features of the present Exhibition, apart from its international character, are improved and more comfortable body work, four-wheel brakes, low-pressure tires, and an increase in six-cylinder models. The extended adoption of the six-cylinder petrol engine is largely due to the introduction of saloon bodies which require silent motive mechanism. The six-cylinder car is delightful to handle, owing to the even torque of the engine, and although it may not be quite so economical as regards fuel consumption, cars so propelled are frequently lighter on tires than those fitted with four-cylinder engines. The six-cylinder car is, moreover, particularly pleasing for

traffic driving, as gear changing is reduced to a minimum. In spite of the great efforts made by advocates of overhead valves during the past three or four years, side-by-side valves still hold their own fairly well by virtue of their simplicity and general reliability. Engines so fitted are not quite so efficient, but have the advantage of fewer parts likely to give trouble. The writer has had extensive experience with both types, and has never experienced broken valves or springs with the side-by-side engine. On the other hand, overhead valves have not been so free from trouble, because the smaller springs, which are employed, have not the same length of life as those on the side-by-side valve.

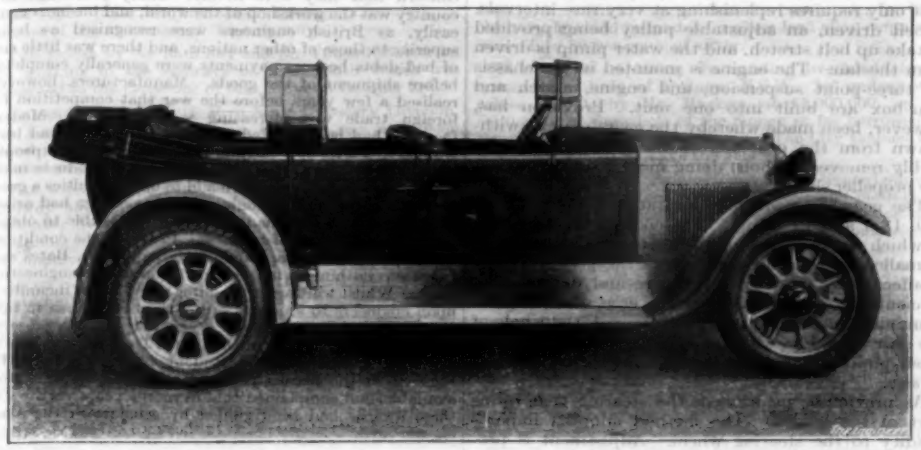


FIG. 5—ROVER 14-45 H.P. FOUR-CYLINDER CAR

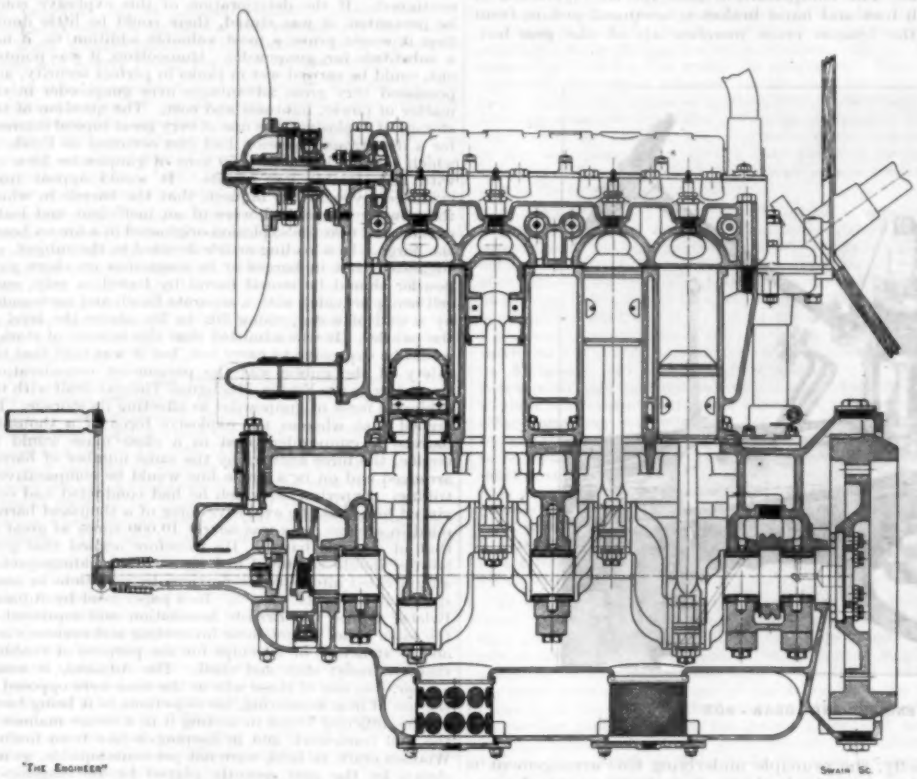


FIG. 6—LONGITUDINAL SECTION OF 14-45 H.P. ROVER ENGINE

There is not much that is really new to report concerning ignition systems. Coil and battery ignition is still fighting the magneto for supremacy, but the latter retains the lead. One of the features of the Show is, as mentioned above, the increasing popularity of the saloon car, probably owing to the extremely bad weather which has been experienced in this country during the last two or three years. This type of body is now being fitted to cars of very low powers, thanks to the introduction of the new body-building material of leather fabric, which is not only much lighter than wood or metal for the panels, but has the additional advantage of deadening all mechanical noises in the chassis.

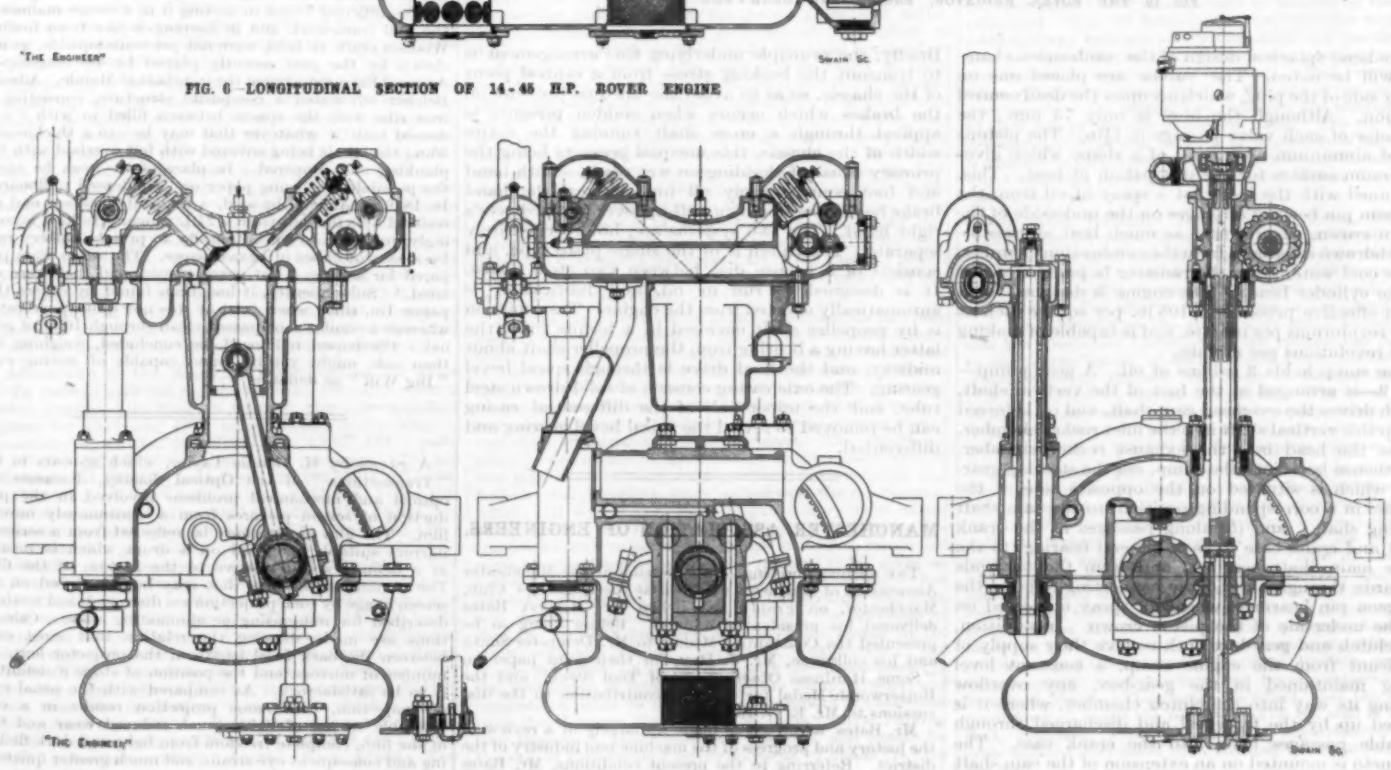
The employment of low-pressure or "balloon" tires is increasing, and many cars are shown so equipped. The chief objections to low pressures are the tendency to produce bouncing, side roll and heaviness of steering. On the other hand, by further eliminating road shocks, the low-pressure tire should prolong the life of cars, and will tend to improve the running of the smaller vehicles in which the suspension is not all that can be desired. The pressures employed are only about one-half those hitherto used.

Daimler Cars.

The Daimler Company's stand is always a centre of attraction. This year the firm exhibits what is claimed to be "the largest car in the world," which is built on a 57 horse-power chassis. All next year's models will be fitted with four-wheel brakes, with a single point adjustment. The Daimler Company makes a practice of supporting the brake cam shaft entirely on the axle of the car. Another feature of Daimler cars is the independent steel frame to carry the body, which is delivered to the body builder in advance. The provision of this second frame preserves the body from distortion, and the doors from jamming. The arrangement of this frame is shown in the illustrations, Figs. 1 and 2. A view of one of the six-cylinder sleeve valve engines is given in Fig. 3. These engines have seven bearings for the crank shafts, and a vibration damper—which is seen just below the fan. An important feature of Daimler engines is the provision of what is called an economy lever, which controls the primer for easy starting, the flow of petrol to the jets, and the water to the radiator. The primer and petrol control are on the carburetter, and the water valve is visible in the upper right-hand corner of the illustration. In spite of the modern tendency to adopt spiral bevel gears for the final transmission, the Daimler Company still adheres to worm gearing, as shown in Fig. 4. For efficiency and silence, this type of gearing compares favourably with any other.

The Rover Car.

One of the few really novel exhibits amongst the British products is the 14–45 horse-power four-cylinder car made by the Rover Company, Limited, Coventry. Fig. 5 is a general view of this car in an unpainted condition. Fig. 10 shows the radiator, engine and gear-box assembly with the carburetter



FIGS. 7, 8 AND 9—TRANSVERSE SECTIONS THROUGH ROVER 14-45 H.P. ENGINE

removed, and Figs. 6, 7, 8 and 9 are sectional views of the engine, which has been designed for the builders by Mr. P. A. Poppe. In the conception of this engine Mr. Poppe has shown much originality. The most noteworthy departures from orthodox practice in motor car mechanism are embodied in the design of the valve gear, the lubrication system, and the steering mechanism, the last named forming a part of the engine. The engine has four cylinders, 75 mm. bore by 120 mm. stroke, with a cubic capacity of 2120 c.c., and is rated for taxation purposes at 14 horse-power. The cylinder head at first sight would appear to house two overhead cam shafts. In reality, however, there is only one, since four tappet rods running across the head operate the exhaust valves, the inlet rockers being worked direct off the cam shaft on the "near" side of the head. The system is ingenious, for only one set of cam shaft driving gear is required, while the tappet rods for the exhaust valves are very much shorter than they could possibly be with a cam shaft located in the crank case. The cam shaft is driven by worm gearing, the whole of which is pressure lubricated. An ingenious arrangement is provided whereby end play in the cam shaft—which, if it occurred, would cause "lag" in the valve timing—can be taken up without dismantling any part of the engine.

It will be observed in one of the sectional views that the rear bearing of the crank shaft is duplicated, and that between the twin bearings is the worm wheel driving the vertical shaft to the overhead cam shaft. This worm wheel is under oil pressure, and the twin bearings are so made as to present a thrust bearing surface to the worm wheel on the crank shaft. Consequently, end thrust in the crank shaft, including the thrust of the clutch, is taken up at this point.

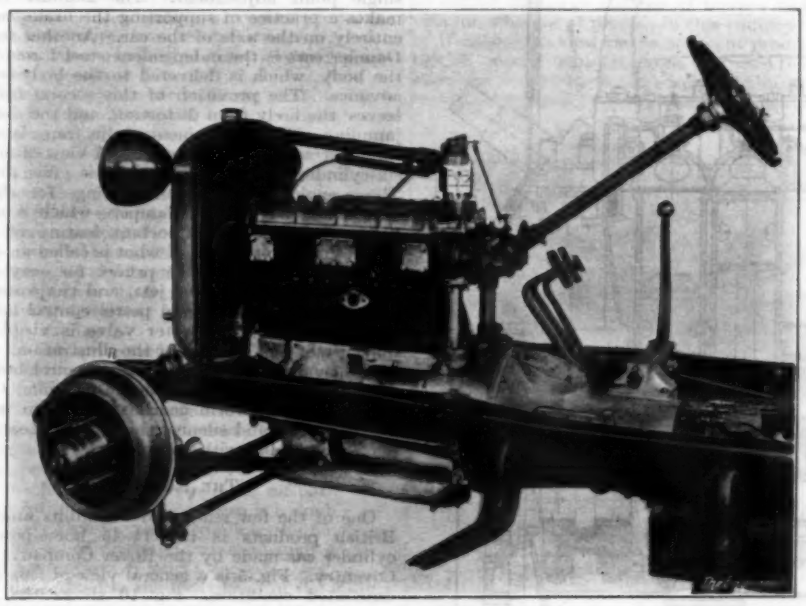


FIG. 10—THE ROVER RADIATOR, ENGINE AND GEAR-BOX

The hemi-spherical design of the combustion chamber will be noted. The valves are placed one on either side of the plug, which occupies the dead central position. Although the bore is only 75 mm., the diameter of each valve passage is 1¼in. The pistons are of aluminium alloy, and of a shape which gives maximum surface for the dissipation of heat. This, combined with the fact that a spray of oil from the gudgeon pin bearing impinges on the underside of the piston crown, ensures that as much heat as possible is withdrawn internally from the combustion chamber, while cool water from the radiator is pumped direct to the cylinder heads. The engine is designed for a mean effective pressure of 105 lb. per square inch at 2000 revolutions per minute, and is capable of making 4000 revolutions per minute.

The sump holds 3 gallons of oil. A gear pump—Fig. 9—is arranged at the foot of the vertical shaft, which drives the overhead cam shaft, and oil is forced (*a*) up this vertical shaft into the inlet rocker chamber, across the head into the exhaust rocker chamber, and thence back into the sump, *vid* the steering gear-box, which is situated on the opposite side of the engine, in a corresponding position to the cam shaft driving shaft; and (*b*) along passages in the crank shaft and crank case to each big end bearing, to the three main shaft bearings, and from the big ends upwards through the hollow connecting-rods to the gudgeon pin bearings, whence a spray is ejected on to the underside of the piston crown. In addition, the clutch and gear-box both receive their supply of lubricant from the engine sump, a constant level being maintained in the gear-box, any overflow finding its way into the clutch chamber, where it is picked up by the fly-wheel and discharged through suitable passages back into the crank case. The magneto is mounted on an extension of the cam shaft drive casing—Fig. 9—and is in the most accessible position possible. The starter motor fits neatly into the fly-wheel casing, while the dynamo is driven by silent chain from the clutch shaft. The fan, which is provided with an oil-circulating system of its own that only requires replenishing at very rare intervals, is belt driven, an adjustable pulley being provided to take up belt stretch, and the water pump is driven from the fan. The engine is mounted in the chassis by three-point suspension, and engine, clutch and gear-box are built into one unit. Provision has, however, been made whereby the gears may be withdrawn from the gear-box or the gear-box may be bodily removed without doing more than disconnect the propeller shaft.

The gear-box provides four ratios, namely, 4.75, 8.9, 13.1 and 19.2 to 1. The ends of the gear-box, in which the bearings for the shaft are mounted, are of malleable iron and the mesh of the gear wheels is unaffected by rise in temperature and different co-efficients of expansion, as is the case when a plain aluminium box is employed. If desired, the whole of the gear assembly, with the exception of the constant mesh pinions, can be withdrawn with the gear-box *in situ*.

As previously mentioned, the steering gear forms part of the engine. The method adopted imparts rigidity to the steering wheel. Adjustment is provided to take up wear and backlash in the steering wheel, and the gear is automatically lubricated from the engine. Brakes are fitted to all four road wheels; the drums are of large diameter and made of high-carbon steel, and the shoes are lined with friction material. The front wheel brakes are of the Perrot type. The compensation gear for the operation of both foot and hand brakes is arranged just in front of the chassis cross member aft of the gear-box. Briefly, the principle underlying this arrangement is to transmit the braking stress from a central point of the chassis, so as to avoid the unequal pressure on the brakes which occurs when sudden pressure is applied through a cross shaft running the entire width of the chassis, this unequal pressure being the primary cause of skidding on wet roads. Both hand and foot control apply all four brakes, the hand brake being operated by a pull-up lever by the driver's right hand. The two systems are, however, entirely separate. The clutch is of the single plate type, and consists of a bronze disc between two steel plates. It is designed to run in oil, and lubrication is automatically effected from the engine. Transmission is by propeller shaft enclosed in a torque tube, the latter having a bearing from the propeller shaft about midway, and the final drive is through spiral bevel gearing. The axle casing consists of solid-drawn steel tube, and the upper half of the differential casing can be removed to reveal the spiral bevel gearing and differential.

MANCHESTER ASSOCIATION OF ENGINEERS.

The opening meeting of the session of the Manchester Association of Engineers was held at the Engineers' Club, Manchester, on Friday last, when Mr. Herbert Bates delivered his presidential address. Before doing so he presented the Constantine Medals to Mr. Dempster Smith and his colleague, Mr. J. Hey, for their joint paper on "Some Hardness Observations of Tool Steel," and the Butterworth Medal for the best contribution to the discussions to Mr. E. G. Herbert.

Mr. Bates' address was made up largely of a review of the history and progress of the machine tool industry of the district. Referring to the present conditions, Mr. Bates said that there had always been periods of depression in the history of engineering, but on former occasions it had only been a question of time before the revival came round and engineers were sure of a good share of prosperity. The general establishment charges were not the serious concern that they were to-day. Many years ago this country was the workshop of the world, and business came easily, as British engineers were recognised as being superior to those of other nations, and there was little risk of bad debts because payments were generally completed before shipment of the goods. Manufacturers, however, realised a few years before the war that competition for foreign trade was increasing very seriously. Modern factories had been erected abroad and the men had been trained to a level approaching that of our own workpeople, whilst the improved designs of the foreign products made competition more severe. To add to our difficulties a great obstacle in the form of high rates of exchange had arisen since the war, which made it almost impossible to obtain a reasonable chance of business. Provided the conditions of competition were approximately equal, Mr. Bates said there was nothing to fear for the future in the engineering trade. Whilst waiting for brighter times it was incumbent upon engineers to study carefully the best course to take for the future of the industry generally and so preserve the supremacy enjoyed in the past. The first step was to attract the best class of student to engineering. He referred to the attractive scholarships which were now available, and complained that in recent years very few of these awards had been gained by scholars in the Manchester area.

SIXTY YEARS AGO.

In our issue of October 14th, 1864, we recorded in a short note that trials with gun-cotton were still being continued. If the deterioration of this explosive could be prevented, it was stated, there could be little doubt that it would prove a most valuable addition to, if not a substitute for, gunpowder. Gun-cotton, it was pointed out, could be carried wet in tanks in perfect security, and possessed very great advantages over gunpowder in the matter of power, lightness and cost. The question of the storage of explosives was one of very great topical interest, for a disastrous explosion had just occurred at Erith, in which a barge laden with 50 tons of gunpowder blew up with considerable loss of life. It would appear from evidence given at the inquest, that the barrels in which the powder was stored were of an inefficient and leaky nature, and that the explosion originated in a fire on board the barge. In a leading article devoted to the subject, we suggested that in barges or in magazines on shore gunpowder should be stored barrel by barrel in cells, each cell being provided with a separate hatch and surrounded by a wall of water, rising 2ft. to 3ft. above the level of the powder. It was admitted that this scheme of storage would be expensive to carry out, but it was held that the safety of the public was the paramount consideration. In a letter to the Editor, Mr. Lynall Thomas dealt with the explosive force of gunpowder as affecting its storage. He argued that whereas the explosive force of a thousand barrels of gunpowder piled in a close mass would be terrific, the force exerted by the same number of barrels arranged end on in a single line would be comparatively trifling. Experiments which he had conducted had convinced him that the explosive force of a thousand barrels piled in a close mass was nearly 10,000 times as great as that of a single barrel. He therefore argued that gunpowder should be stored in long narrow buildings preferably divided into separate portions by partitions or small spaces at intervals. . . . In a paper read by Admiral Belcher before the British Association and reprinted in the same issue, we get some interesting and curious views on the structure of warships for the purpose of enabling them to resist shot and shell. The Admiral, it would appear, was one of those who at the time were opposed to the use of iron armouring, his objections to it being based on the difficulty found in uniting it in a secure manner to the hull framework and in keeping it free from fouling. Wooden craft, he held, were not yet contemptible, as was shown by the part recently played by the flagship of Admiral Farragut against the ironclads at Mobile. Admiral Belcher advocated a composite structure, consisting of iron ribs with the spaces between filled in with "condensed teak"—whatever that may be—to a thickness of 36in., the whole being covered with felt overlaid with 6in. planking and coppered. In place of the teak he raised the possibility of using paper or "condensed millboard." In 1816 at Algiers, he said, a ream of foolscap, end on, resisted a 68 lb. shot from a 27ft. range. He had, accordingly, proposed to the Admiralty to protect battery rafts by means of cubes of brown paper. The cubes were prepared for testing, "but peace ensued, and they were not tried." Subsequently, it had been found by others that paper 1in. thick when fired at was not quite penetrated, whereas a similar shot passed clean through 10in. of good oak. Condensed millboard, he concluded, weighing less than oak, might yet be found capable of setting even "Big Will" at defiance.

A PAPER by H. Dennis Taylor, which appears in the "Transactions" of the Optical Society, discusses the optical and mechanical problems involved in the production of screen pictures from a continuously moving film. The film picture may be reflected from a series of mirrors suitably mounted on a drum which is rotated at a definite speed relative to the motion of the film. The various oscillations that may be introduced on the screen image by such projection are discussed, and methods described for minimising or eliminating them. Calculations are made showing the relation that must exist between the back focal length of the projector lens, the number of mirrors, and the position of stops if definition is to be satisfactory. As compared with the usual type of projection, continuous projection results in a considerable saving of light, much reduced wear and tear of the film, complete freedom from light and dark flickering and consequent eye strain, and much greater quietness in running.

Railway Matters.

Engine No. 111 on the Great Western—the famous Great Bear—has been renamed Viscount Churchill, in honour of the chairman of the company.

The report by Sir Sam Fay and Sir Vincent Raven on the working of the railways of New South Wales was presented to the Governor of that State on October 3rd.

Under an Order of the Free State Chancery Division, the Listowel and Ballybunion Railway has now been closed. This railway was the subject of a note in our Journal page of September 12th.

The whole of the staff employed by the East Indian Railway have been given notice to leave the service on December 31st next, as the State takes over the system on January 1st. These notices are a matter of form, as the employees will automatically transfer their services.

As on September 1st the cost of living was only three points higher than on June 1st—72 as against 69—there will be no change this quarter in the wages of those men who come under the railway conciliation scheme. A change of five points means a rise or fall of one shilling; those men who have already reached the minimum are not affected by any fall.

The "Proceedings" of the Institution of Railway Signal Engineers for the first half of the present session have just been issued and copies, at seven shillings and sixpence each, may be obtained from the secretary, Mr. M. G. Tweedie, 80, Caversham-road, Reading. Included in the volume is a very interesting paper, "A Survey of Indian Signalling," by Mr. A. C. Rose.

Now that the Glasgow Subway has passed into the possession of the Glasgow Corporation considerable improvements are to be made. Additional entrance is to be provided at St. Enoch's-square, whilst that at Buchanan-street is to have a new entrance at the corner of West George-street. The stations at St. George's Cross and Kelvin Bridge are to be reconstructed.

All the locomotives and passenger vehicles on the Brighton section of the Southern Railway are gradually being taken into the shops to be fitted with the vacuum brake. This, in part, accounts for trains losing time in running, as a good deal of the work to-day is being done by the older engines. Many South-Eastern coaches are also in the shops being converted into electric motor vehicles.

After twenty years in the position of superintendent of motive power to the Cleveland, Cincinnati, Chicago and St. Louis Railway, Mr. W. Garstang retired in 1913, and his death is now announced. He was born in England in 1851, and went to the United States as a child. He had always been an authority on locomotives, and was the reporter for America on the subject of locomotives for very high speeds at the Berne International Railway Congress in 1910.

The directors of the London and North-Eastern Railway, at their meeting on October 3rd, authorised the provision of an electrically operated automatic mechanical coaling and sanding plant for their locomotives at Doncaster at a cost of £30,000. The plant will enable the coaling and sanding of engines to be performed much more readily and at a considerably reduced cost than with the present methods by hand. It will also increase the time during which the locomotives will be available for traffic purposes. Coal and sand will be supplied simultaneously.

A message from Reuter's Paris correspondent, under date of October 9th, says that there are still in France many temporary wooden bridges built by British military engineers, and many miles of railway which were laid down by the sappers to improve communications with the front. Since the Armistice these lines have been, in many cases, allowed to fall into disrepair, and in at least one instance a whole railway disappeared, it afterwards having been found that it had been stolen, both rails and sleepers being carted away secretly. Measures are now being taken to preserve these lines where they are found to be of public utility, and the *Journal Officiel* publishes a decree providing for their maintenance.

The failure of an engine tire on a London, Midland and Scottish up express when running through Weedon last Sunday has again drawn attention to locomotive failures. We would therefore say that fifty-four failures of tires were reported in the five years 1911–1915, and in the five years 1919–1923 there were seventy-three. Last year there were eighteen failures, but this increase above the average may be due to the "more comprehensive system of reporting accidents due to the amalgamation of the railway companies," mentioned by Colonel Pringle in his recent annual report. Judged by the mileage run—nearly 400 millions a year—failures are uncommonly rare. On the other hand, as there have been during the ten years above named 127 failures of engine tires, or an average of about one per month, an occasional mishap of this kind is not the phenomenon the general public may think.

According to the Board of Trade returns the value of the railway material exported during the eight months ended August 31st was as follows, the corresponding figures for 1923 and 1922 being added in brackets:—Locomotives, £1,414,795 (£1,931,510, £3,237,184); rails, £1,177,720 (£1,568,119, £1,796,625); carriages, £792,659 (£692,448, £1,122,712); wagons, £2,320,680 (£1,971,204, £2,313,497); wheels and axles, £425,106 (£664,101, £906,700); tires and axles, £426,013 (£370,415, £302,174); chairs and metal sleepers, £914,089 (£576,179, £1,583,433); miscellaneous permanent way, £781,782, (£727,947, £1,008,334); total permanent way, £3,873,356 (£4,112,170, £5,730,759). The weight of the rails shipped was 128,844 tons (175,145 tons, 176,645 tons), and of the chairs and metal sleepers, 72,945 tons (51,223 tons, 111,490 tons). During the month of August locomotives of the following values were exported to the countries named:—South Africa, £8150; other countries in South America other than the Argentine, £11,479; the Argentine, £5121; other countries in Europe than Spain, £4580; India, £3266; Australia, £1029. Rails were shipped in August as follows:—Argentine, £29,687; Chili, £18,418; India, £13,718; Australia, £8936; South Africa, £7464; New Zealand, £4924.

Notes and Memoranda.

Some experiments carried out at the Columbia University, New York, suggest that the best anodes for brine electrolysis would be made of a silver-lead alloy containing from 60 to 80 per cent. of silver.

The cost of replacing the existing overhead electric transmission lines of Sydney, N.S.W., by underground cables is put, by Mr. Mackay, at £5,000,000, or the equivalent of the whole of the money so far borrowed by the electricity supply department. The City Council has, however, decided to make the change.

According to Mr. Frank Hodges, if we treated our coal now burnt as raw fuel by modern scientific methods of carbonisation, we should have available every year twice our present consumption of motor spirit, in addition to crude oil, nearly 2,000,000 tons of sulphate of ammonia for the cultivation of the soil, and over 100,000,000 tons of smokeless fuel.

If Mr. Henderson's Factory Bill is passed, Clause 137, of which the following is an abstract, will considerably extend the definition of words "steam boiler" and "steam receiver." "Steam boiler" means any closed vessel in which for any purpose steam is generated under pressure greater than atmospheric pressure. "Steam receiver" means any vessel or apparatus used for containing steam under pressure greater than atmospheric pressure for the purposes of heating, boiling, drying, evaporating, vulcanising, or other similar purposes.

Canada is noted for the abundance and variety of its sulphide ores. A special process is designed to treat any ore containing a preponderating amount of iron and sulphur in such a way as to recover all its ingredients. Thus the Sudbury ores would yield sulphur and electrolytic iron in addition to the copper, nickel, and precious metals now recovered, states the Agent-General in London for the Province of Quebec. In the case of the newly discovered sulphide ores in Rouyn township, Quebec, sulphur, iron, copper, gold and silver would be recovered. There are numerous deposits of admixed copper and iron sulphides in the eastern townships of Quebec, whose economical use has long remained a problem. This special process would resolve this ore into sulphur, iron and copper—the whole of the ore being thus turned into saleable products. Recently it has been found that the process is applicable also to the recovery of lead and zinc.

A recent report from the Research Department, Woolwich, gives an account of an investigation on the properties of medium carbon steel, with high manganese content, by Mr. J. A. Jones. It appears from his results that after oil-hardening at 850 deg. Cent. and tempering at 650 deg. Cent., all the mechanical properties of a 0.4 per cent. carbon steel are improved by the presence of about 2 per cent. of manganese. The improvement is still maintained at 3 per cent., but the additional manganese shows no advantage and may introduce difficulties in forging. Steels with high manganese content are extremely liable to show temperature brittleness when slow rates of cooling after tempering are employed, but this may be avoided by suitable heat treatment. If good impact figures are to be secured, the cooling from the tempering temperature must never be slower than in air. For purposes for which it is desired to replace carbon steel forgings by steels of greater strength, the author suggests carbon from 0.35 per cent. to 0.40 per cent., manganese from 1.8 per cent. to 2.2 per cent., oil-hardened from 800 deg. to 850 deg., tempering from 610 deg. to 650 deg. Cent., and cooling in air, oil or water.

In marine boilers, when a water gauge is in working order, the water in the glass, immediately after testing, rises above the level at which it previously stood, but if left undisturbed steadily returns to its former position, assuming, of course, that the water in the boiler keeps at the same level. The amount of rise depends on the temperature of the water in the boiler, and the length of the connecting pipes between the gauge pillar and boiler. In high-pressure boilers it may amount, according to *Vulcan*, to as much as 4in., while the time occupied in sinking to the normal level ranges from thirty to forty minutes. The rise of the water level is due to two causes: (1) the displacement of the comparatively cold water connection by hotter and proportionately lighter water from the boiler; (2) the slight condensation and corresponding reduction of pressure in the steam connection. The cause of the subsequent fall to its former level is also twofold, viz.: (1) the cooling of the water connection, and (2) the diminution of condensation in the steam connection owing to the accumulation of air therein from the steam condensed. These results are further affected by the condensation of steam in the upper part of the gauge in boilers using salt water causing the water to be fresher and less dense than in the boiler.

The first report of the Coal Dust Committee has just been issued by the Government of India. The terms of reference were to inquire into the danger of explosions of coal dust in Indian coal mines; to make experiments on different kinds of coal dust with a view to determine their liability to explode or otherwise; and to report what means, if any, are necessary or desirable to provide against risk of coal dust explosions in Indian mines. The report (1) gives a brief review of the evidence of the explosibility of coal dust in air, making a comparison between Indian and British and American coals as regards their inflammability; (2) describes a series of preliminary tests of the inflammability of Indian coal dusts; (3) discusses the conditions with respect to coal dust in Indian mines and makes suggestions regarding its removal; (4) gives an outline of some of the aspects of shot firing in Indian mines from the point of view of the danger from coal dust, and makes recommendations regarding the provision of clay for tamping purposes at convenient points in the mine, and the use of "permitted" explosives; and (5) invites attention to the necessity for improvement in the ventilation of mines in which fire-damp is found and suggestions made to that end. The report is obtainable from the Manager, Government of India Central Publication Branch, 8, Hastings-street, Calcutta, and agents for the sale of Government publications at 12 annas (1s.) per copy, excluding postage.

Miscellanea.

The output of the Natal coal mines during July was 355,463 tons.

The new Mersey dock, which is to be built at Bromborough for Lever Bros., will probably cost over half a million sterling.

A German firm is asking permission of the Chinese Ministry of Communications to install wireless telephone services between Peking and Tientsin and Tientsin and Shanghai.

Negotiations have been completed by which John Lysaght, Limited, of Bristol and Newport, acquire a substantial interest in the Dominion Sheet Metal Company, of Hamilton, Ontario.

By December, 1925, the two most important works in progress affecting hydraulic development in the Province of Quebec, namely, the gigantic dams at Grande Decharge and Kenogami, will, says the *Canadian Engineer*, be completed.

A company financed by Russian capital has been organised to work the coal mines at Muling, Kirin Province, Manchuria, it is reported. A light railway to connect the mining area with the Chinese Eastern Railway at Muling Station is being built.

It has been decided by the Johannesburg Town Council to lay a high-tension underground cable from Norwood Transformer Sub-station to a transformer kiosk to be erected in Oaklands for the supply of electric light to that district. Tenders will be called for shortly.

The Administration of the South African Railways does not intend to proceed with the second section of elevators until such time as it has had more information and an opportunity of seeing how the first section will work. Farmers have taken great advantage of the elevators. The Cape Town elevator is complete, and the foundations of the Durban elevator are now proceeding satisfactorily.

The Municipality of Bethlehem (Orange Free State) is seeking permission to construct a dam on the Town Lands across the river Jordan. It is proposed to impound and store the normal flow to which the municipality may be entitled of the Jordan River and of a tributary on which the present dam is situated. The volume of water held up by the existing dam is stated to be 260,000,000 gallons, while the proposed dam will hold up 1,300,000,000 gallons. The application will be heard before the Water Court, at Bethlehem, on March 17th, 1925.

We learn from Cox and Danks, Limited, that a sixth torpedo destroyer from the scuttled German Fleet at Scapa was successfully raised on Monday evening last. We have already commented on the extreme regularity with which the programme of salvage operations is being carried out. This last ship created what is probably a record in salvage work. Operations were begun on Thursday afternoon, the 9th inst., and work was continued on the Friday and Saturday, a rest being taken on the Sunday. The work was then so well advanced that the ship was salved on Monday evening.

It is reported by the National Federation of Iron and Steel Manufacturers that the production of pig iron in September amounted to 569,200 tons compared with 588,900 tons in August and 615,600 tons in July. The number of furnaces in blast at the end of the month was 170, a decrease of 3 since the beginning of the month, and the lowest number in blast since December, 1922. The production includes 187,100 tons of hematite, 183,500 tons of basic, 145,500 tons of foundry, and 29,300 tons of forge pig iron. The output of steel ingots and castings in September amounted to 645,000 tons compared with 527,500 tons in August—when production had been affected by the holidays—and 689,300 tons in July.

In a rail car which was recently completed by Schneider et Cie., for service on the Paris suburban line of Poissy to St. Germains, a new arrangement of machinery has been employed. The 60 horse-power four-cylinder engine is fixed midway between the driving axles and parallel and near to one side of the car. By means of gearing, power is transmitted to a central cardan shaft, which drives both axles. Inspection doors fitted in the side of the car body give access to the motor, and radiators are arranged one at each side of the two inspection doors. The car can be driven from either end, and the arrangement of the motor is claimed to give a better equilibrium, whilst the whole of the mechanical parts are concentrated within the wheel-base of the vehicle.

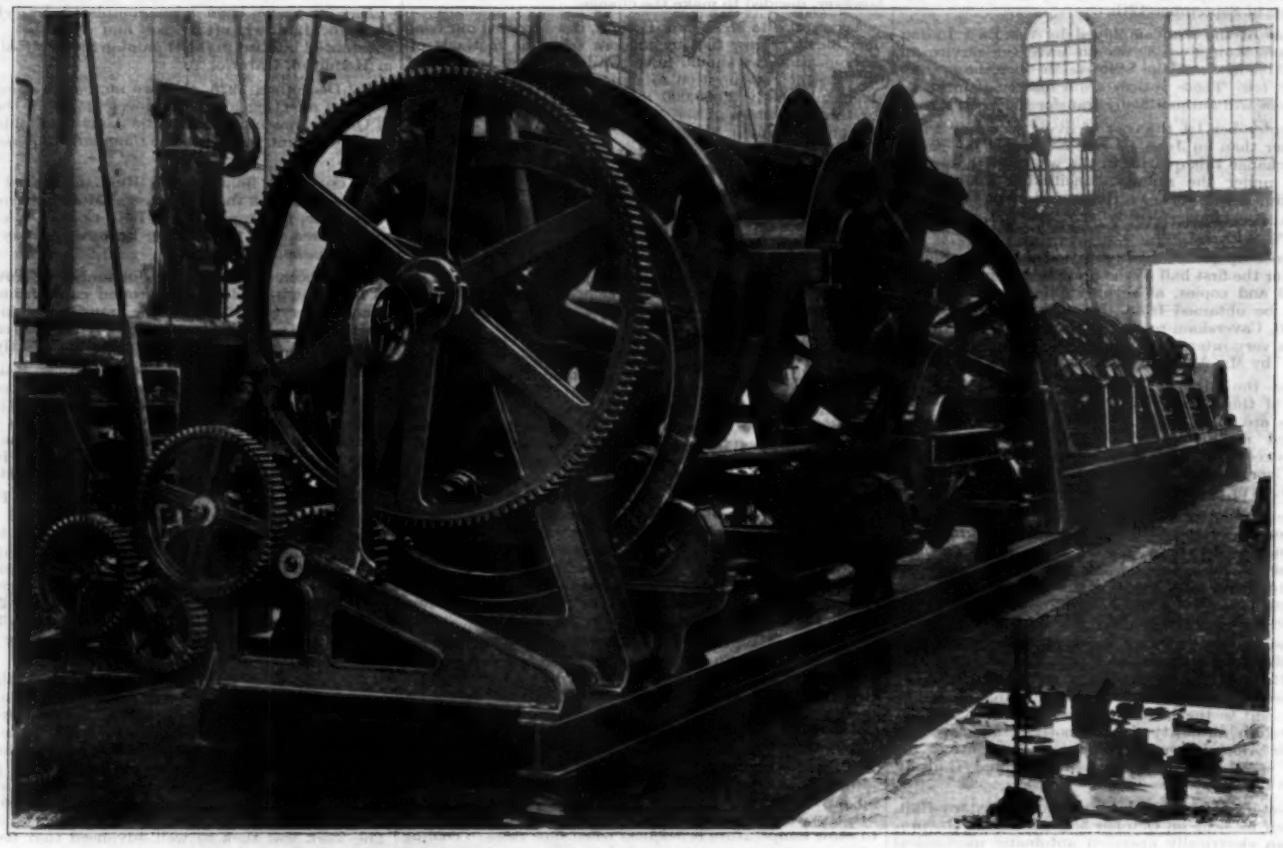
The King William's Town, South Africa, Borough Council has for some time had under consideration the erection of a new and thoroughly up-to-date electrical power station and has decided to proceed with the scheme. The site selected is above all flood levels and will adjoin the railway, thus effecting economies in the handling of coal, &c. Subject to the approval of the Administrator and the Electricity Commission, the council has decided to accept the tender of Reunert and Lenz, Limited, for plant, totalling £23,507, and that of Messrs. Siemens (S.A.), Limited, for cable, &c.—£1525. The local work, which includes railway siding, water supply, cable laying, foundations, &c., will amount in the aggregate to £4968, making a total of £30,000 for the complete scheme.

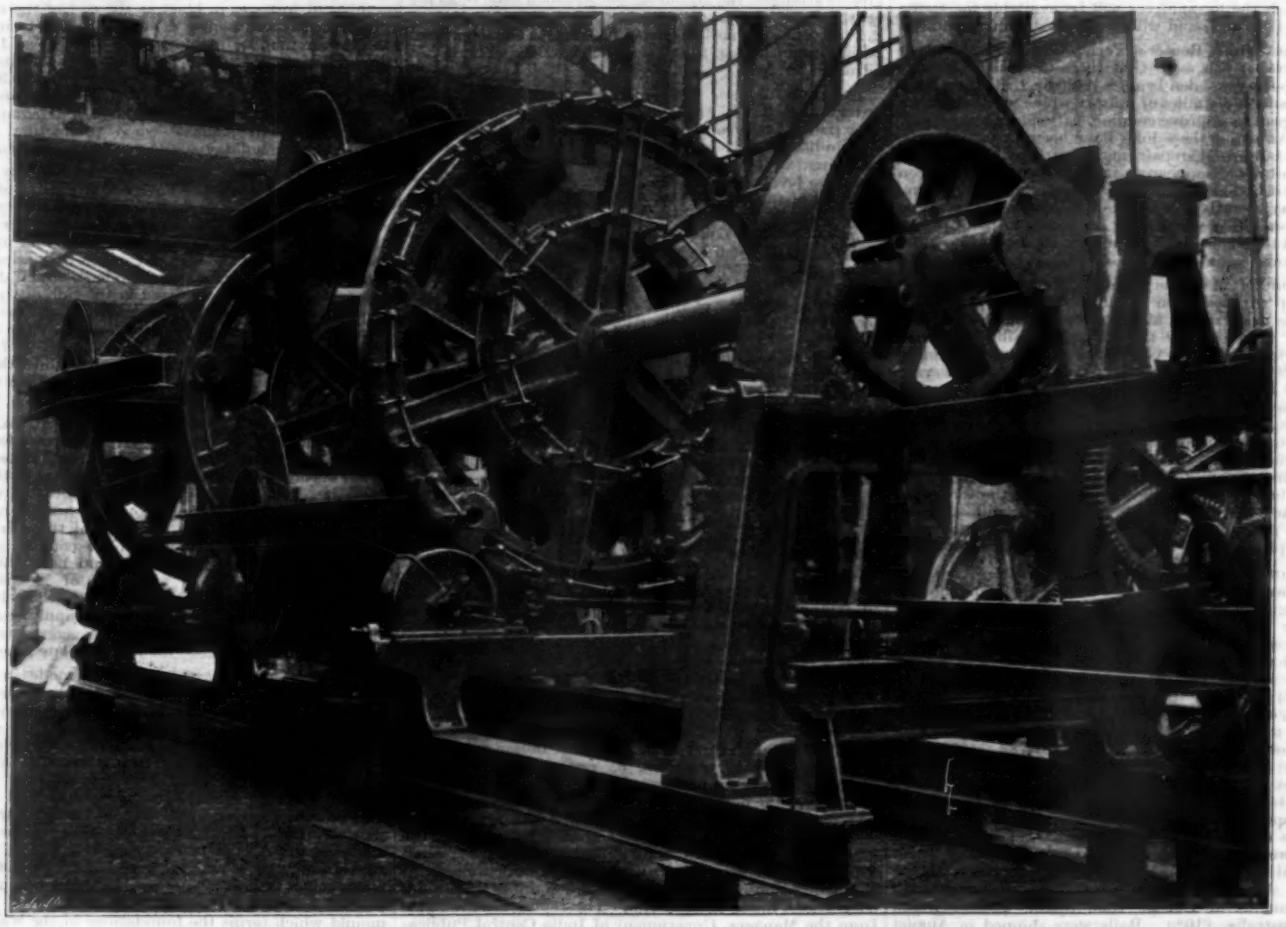
Considerable progress has been made in the Back Bay Reclamation in Bombay during the quarter ending with June last, says the *Indian and Eastern Engineer*. At the northern end of the reclamation, where it connects with the existing shore line at Kennedy sea face the wooden pile gantry which forms the core of the wall has been completed to a length of 6550ft., whilst the construction of the rubble mass concrete wall has closely followed the erection of the gantry and is now only 50ft. short of the latter. Equally good progress has been made at the Colaba end of the reclamation, where the rubble mound has reached a length of 10,000ft. and the mass concrete superstructure has been completed to a length of 5740ft. This means, in effect, that the rubble mound which forms the foundations of the wall is 75 per cent. complete, whilst the concrete superstructure has been finished over more than one-half the total length of the wall.

LARGE ELECTRIC CABLE MAKING MACHINE

THOMAS LARMUTH AND CO., LIMITED, MANCHESTER, ENGINEERS

(*For description see page 433*)





FIGS. 105 AND 106—SIX-CORE LAYING-UP MACHINE WITH FORTY-EIGHT-BOBBIN PAPER LAPPER AND COPPER TAPING GEAR

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DEATH.

On October 6th, H. S. Millington, for seventeen years in the service of, and latterly works manager of the firm of George Ellison, of Perry Barr, Birmingham.

THE ENGINEER.

OCTOBER 17, 1924.

Hardness Testing Again.

Although the Brinell ball test is so widely used and in its value universally recognised, we find that investigators and research workers as well as practical engineers still devote a large amount of time and ingenuity to its further improvement or even to the devising of alternative methods of measuring "hardness." At the recent autumn meetings of both the Iron and Steel Institute and the Institute of Metals important papers dealing with this subject were presented. This fact suggests that in its usual form the ball indentation test does not meet all the needs either of the investigator or of the engineer. Thus, within a relatively short period of time we see such introductions as the Rockwell hardness tester in America and the Herbert pendulum tester in England. Without entering into any detailed comparison of these methods some outstanding points are worthy of comment.

The Rockwell test, while of considerable interest in itself, suffers from the disadvantage, which is serious from the practical point of view, that its indications cannot be readily converted into "Brinell numbers." This means that the Rockwell cone indentation measures something which, while of the general nature of "hardness," is not the same property as that tested by the Brinell ball. The true nature of this difference is well worthy of closer study, since, at first sight, both methods appear to measure the resistance of a material to local plastic deformation. The Herbert pendulum tester, on the other hand, while capable of giving figures closely comparable with Brinell numbers, also claims to measure something further—the work hardening properties of the material. This instrument has been carefully studied by Professor Benedix, of Stockholm, and the conclusions he has reached should serve to draw attention to the possibilities of this type of "hardness" tester and its future developments. In its present form it suffers from some at least apparent disadvantages compared with a simple Brinell ball and press, but it may well be that the extra delicacy and complication are well worth while for the sake of the extra information which the instrument can furnish. Here the true test is, essentially, one of experience and of consistent correlation with service behaviour. The property of "work hardening" has hitherto only received vague general consideration. It is now likely to be studied in detail, and such study should lead to important results, especially in view of the relation which seems to exist between work hardening and resistance to fatigue. With regard to the standard Brinell test itself, interesting points have also been raised in recent papers. Dr. Hultgren, of Sweden, has produced a super-hardened type of ball for making indentation tests on very hard materials and has thereby undoubtedly succeeded in extending the applicability of the test to steels of higher hardness. For some special purposes this achievement may prove of considerable practical value; it certainly is so from the point of view of the scientific investigator of metals. The more interesting aspect of Dr. Hultgren's work, however, is the fact that he has succeeded in super-hardening fully hardened steel by a process of cold working. The fact that subjecting fully hardened steel balls to running under severe loading leads to further hardening is of considerable importance and will be, to many, sufficiently surprising. It suggests that in the hardness of so-called "glass hard" steel the fullest capabilities of the material have not yet been developed. Considerations of theoretical physics, indeed, suggest that the internal cohesive forces of an aggregate of iron atoms should yield much greater strength and hardness even than this, but the difficulty of realising such a condition in any metal have yet to be overcome, and one has regarded hardened steel as the nearest practicable approach to the development of the full cohesive strength of iron. Now we find that this hardened material is still capable of undergoing further hardening by cold working, and although the degree of further hardening which has been achieved is not perhaps very great, it represents a step upon a new path. Efforts to produce such super-hardened materials in this or other ways are likely to follow, with, possibly, far-reaching consequences.

The immediate practical results of these advances in the study and testing of hardness are not, perhaps, of a very striking character, but in these days of intensive scientific research and of rapid development of new processes and new products it is necessary to pay careful attention to the beginnings of new developments such as they. We are apt to glory unduly in the great achievements of engineer and metallurgist to-day, and to forget that we still live in an age of rapid progress. Provided that we are not again interrupted in our advance by national calamities, progress is certain to be even more rapid than it has yet been. It is given to but few of us to foresee even dimly the nature and direction it is likely to assume. When, therefore, we can and do recognise the germs of new developments it becomes the more important to take careful note of them. We in this country are all too ready to display indifference until we find that others have turned into profitable industry what we have been inclined to regard as little more than curiosities. We cannot afford to continue neglect of that kind.

Education.

We discussed recently in these columns—see The Engineer, September 19th—some aspects of technical education, and suggested that the time had come for the calling of a conference to review the results that have followed the adoption of principles laid down more than twenty years ago. Our attention is drawn again to the subject by a remarkable article which we publish in this issue. The author is Mr. John Rhodin, and the title "The Failure of Intensified Research Work in England." Mr. Rhodin is a Swede, but he has lived in this country for many years, and has had ample opportunities for comparing the educational methods of his own country and of ours. He recognises the bearing of education upon research, and he implies rather than says so specifically that the failure of intensified research in this country may be ascribed to our system of scientific education. He seems to us to bear out the argument advanced in our article of September 19th, that not enough attention is paid in England to the foundations of knowledge and to the cultivation of the scientific method of thought. It will be noticed with some surprise, by those, at least, who are not acquainted with Sweden, that botany is one of the fundamental studies for science students in that country. He tells us that its value as a training lies in the "enormous benefit derived later from an early acquaintance with co-ordination of characteristics," and that "the subject is taught for training the powers of observation as being the least costly one, besides offering more variety

ready to hand than the school laboratories which came later on."

It is quite conceivable, as Mr. Rhodin himself suggests, that botany could not be used as readily in this country as in Sweden for the fundamental training in the principles of science. But the particular subject employed for that purpose is of relatively small consequence, provided the purpose itself is recognised. It is, we venture to suggest, the failure of most of our technical schools and colleges to recognise it that constitutes the weak point in our teaching of to-day. The immediate utilitarian aspect of education dominates the position. The first question that springs to the lips of parents, students and employers is always, "Is it going to be of any use to him in his career?" Very few persons can see that an apparently useless subject, as, for example, botany, may, in fact, give a far better training in the elementary principles of the scientific method than one having a direct value in the branch of science which the students proposes to follow in after life. It is, we fear, undeniable that little or no real training in observation is given to engineering students before their post-graduate course begins. They make, it is true, a certain number of experiments in various laboratories, but as they, at that period, lack the skill to use delicate apparatus, they reach figures which can be only made to conform with the fore-known results by careful cooking. Very few students have the courage to be true to themselves and set down on paper exactly what their observations have shown them. They get gross errors because they have not the training that ensures accuracy, and because the apparatus that does duty in school laboratories can never be maintained at that pitch of excellence which the delicacy of many experiments demands. It may be questioned if a system which inevitably leads students to falsify their accounts does not have a permanently bad effect upon all but the strongest minds. It is probable that a single, fairly simple experiment, well carried out, though it took a whole term to perform, would give better mental training than half a dozen scamped and corrected by the assistance of the note-books of preceding students or the records to be found in text-books. There is, we know, another point of view. It is held that the student's mind is broadened by contact, even if it be but brief and imperfect, with a variety of subjects, and that it is only in the college laboratories that he will ever have the opportunity for acquiring knowledge of experimental methods. In later years, when he is serving his time or earning his living, he will neither have the time nor the conveniences for pursuing experimental science. All this we must admit. It is just because such opposite standpoints with regard to technical education may be taken up that the solution of the educational problem is so difficult, and it is the need of finding some *via media*, some way that would remove the principal defect of the training of engineers in England, whilst retaining the advantages of a broad education, that we have suggested the calling of a Conference. Our own view, as we have already said, is that too much is attempted and that more satisfactory results would be attained by concentration on fewer, selected subjects, not necessarily subjects of immediate utilitarian value but any that trained the mind to clear scientific methods and consolidated the foundations of scientific knowledge. The root of the present trouble is, as it has always been, the examination system. Most of our colleges are now in too large a measure coaching institutions for the B.Sc., a degree which demands a more extensive knowledge than can be thoroughly acquired in the three years or so that are given to it. Probably far better men would be produced if no more than two subjects, or at most three, had to be taken for the degree examinations. At the Conference which we trust it may be possible to convene at no very distant date, we should be glad to see the whole problem of degree examinations very closely considered. It should, surely, be possible to make them a true test of capacity and to remove from them the stigma under which they have so long laboured that they encourage cramming.

The result of the system that prevails to-day is to produce young men who have a superficial knowledge of a great many things but a real knowledge of none. They are taken in a wholly inadequate time through advanced branches of science, whilst the foundations on which that science rests are not clearly understood. In part, the excessive attention to mathematics is to blame for their weakness on fundamental principles. All too often they know how to reach certain ends by the use of figures, but were they asked to visualise what the figures meant they could not do so. To young engineers this is a grievous disadvantage, for it is obvious that unless a logical discussion of causes can be pursued improvement is impossible. Let us illustrate our meaning by a simple example. As long as it was unknown why the actual indicator card differed from the theoretical card no means of improving the steam engine were possible; when, however, the effects of initial condensation and re-evaporation were fully understood then the road towards the improvement of the engine was opened. It is so with every branch of science; unless the physics are fully understood the mathematics are valueless. But a knowledge of the physics implies a thorough acquaintance with fundamental principles, and once they are acquired a mathematical examination can be built up on them. There is, we would repeat in conclusion, a fear in our mind that in the effort to teach too much, and to keep pace with the latest advances of science in too many directions, students are leaving our colleges with a less thorough acquaintance with the basal physical facts than they ought to have.

One Hundred Years of British Railways.

No. XVI.*

PART II.: THE FIRST HALF CENTURY.

THE GREAT WESTERN RAILWAY.

We have now seen how the Great Western, by its own lines or by those it subsequently absorbed, stretched from London to Exeter and Plymouth, from Didcot to Birkenhead, from Oxford through Worcester to Wolverhampton, and from Swindon, through Gloucester, to Milford Haven.

The next railways to be noticed are those in Cornwall. There were two of them—the Cornwall and the West Cornwall. Both were sanctioned in August, 1846; in fact, by consecutive Acts. The West Cornwall was, however, finished first and therefore claims prior notice. It ran from a junction with the Truro-Falmouth line of the Cornwall Railway in the parish of Carredras near Truro to Penzance. Powers to purchase the Hayle Railway were obtained in 1839, and because that line was of the standard gauge the Act authorised the West Cornwall to be on the same gauge so that the engines and rolling stock of the Hayle line might be used. It was, however, provided that should any other railway be made in Cornwall the Railway Commissioners could order the West Cornwall to adopt the broad gauge or to lay down an additional rail to suit the broad-gauge system. When through-communication from Plymouth was established the latter alternative was adopted. The last portion of the line to Penzance was opened on July 16th, 1855, four years before the Cornwall Railway reached Truro. There were ten of the well-known Brunel-built wooden viaducts between Truro and Penzance. They have all now disappeared, having been replaced by stone structures.

We come now to the Monmouthshire and the Newport, Abergavenny and Hereford Railways. The former was sanctioned by 8 & 9 Vic., c. 169, 1845, which authorised the Monmouthshire Canal Company to alter its tramways and, in particular, the section of its Eastern Valleys line lying between Newport and Pontypool, into railways suitable for use with locomotive power. The Newport, Abergavenny and Hereford belonged mainly to the same interests. It was sanctioned by 9 & 10 Vic., c. 303, 1846, and ran from the Monmouthshire Railway at Panteg, through Pontypool-road and Abergavenny, to a junction with the Shrewsbury and Hereford at Hereford. In the following year a line from Pontypool, through Crumlin, to join the Taff Vale at Quakers Yard was authorised. On this line are some severe gradients—one is of 1 in 42—and two tunnels, but the chief feature is the Crumlin Viaduct over the Western Valley. It is 1500ft. long, the greatest height is 200ft., and the average height 138ft. It is an iron structure with ten spans of Warren truss girders and it cost £39,000. A reminder of the early days of railways is found in the name of "Tram Inn" of the last station before Hereford is reached.

Another little railway of this period was the Coleford, Monmouth, Usk and Pontypool. It was absorbed by the Great Western in 1881.

In 1854 the present Paddington terminus was opened. It had ten roads and three platforms. The present No. 1 platform was one of the latter, and there was another between Nos. 2 and 3 roads and a third between Nos. 9 and 10. An engine, after arrival in one or other of the last-named roads, went forward on to a sector and was able thereby to pass on to the other road and get away. There was the usual large number of turntables and some were 22ft. diameter. The latter were used for reversing the travelling post office vehicles so that the mail exchanging apparatus was always on the left-hand side in the direction the train was running. Communication between Nos. 1 and 2 platforms was given by means of two traversing platforms which, when not needed, were telescoped under the fixed platform. One of them was still in use until quite recent years. The station, which cost £650,000, was, when built, 700ft. long, 238ft. wide, and divided into two side spans of 68ft. each and a central span of 102ft., crossed by two transepts 50ft. wide. The provision of the new passenger station led to the goods station being erected on the site of the 1838 station.

The Hereford, Ross and Gloucester Railway—14 & 15 Vic., c. 40, 1851—ran from Hereford to Grange Court, where it joined the Gloucester and Dean Forest—the line that connected the Cheltenham and Great Western Union to the South Wales—and was opened on June 1st, 1855. It has three tunnels, several big bridges over the Wye, and the average gradient is 1 in 70. It was purchased by the Great Western in 1862. The Wycombe Railway was incorporated by 9 & 10 Vic., c. 236, 1846, and revived by 15 & 16 Vic., c. 147, 1852. It ran from Maidenhead to High Wycombe and by subsequent legislation was extended (1) to Princes Risborough and Aylesbury, (2) from Princes Risborough to Thame, and (3) Thame to Oxford. The last section was opened on October 24th, 1864. Amongst other lines that were opened in 1855-56 and 1857 and in due course absorbed by the Great Western were the Chipping Norton, the Abingdon, the Uxbridge, and the Leominster and Kington.

A serious accident occurred on August 23rd, 1858. Whilst the first portion of an excursion train was on the 1 in 75 rising gradient near Round Oak a coupling broke and eighteen carriages ran back and collided with the second portion. Fourteen passengers were killed. It was stated at the inquiry that the brake van was filled with children and that there were male and female passengers on the footplate of the engine.

On May 4th, 1859, the Cornwall Railway was opened from Plymouth to Truro; this section included the Devonport branch of the South Devon taken over by the Cornwall. As already related, the West Cornwall had, if ordered by the Railway Commissioners, to lay down a third rail for the broad-gauge stock of the Cornwall. Similarly, the Cornwall was required to lay down a third rail between Truro and Falmouth for the standard-gauge stock of the West Cornwall. At Saltash the railway crosses the river Tamar by the Royal Albert Bridge, one of Brunel's masterpieces. The river at this point is 1100ft. wide, and the Admiralty, in view of the proximity of Devonport Dockyard, required a headway of at least 100ft. and not more than four piers in the river. The bed of the river was found to be unstable, so Brunel, with characteristic courage, decided on two big spans so that he would only have one pier in deep water. The top member of these two spans is an arched elliptical wrought iron tube, 16½ft. by 12½ft. and 455ft. long, which supports girders at track level by heavy suspension chains. Each span weighed 1060 tons and the same plan was adopted as at the Britannia bridge—the spans were erected on shore and floated out. When in position the pontoons were sunk, the ends of the span rested on the bases of the piers and were raised 3ft. at a time and the piers followed. Including the approaches of seventeen spans in all the length is 2200ft. and the rails are 110ft. above high water. The cost was £225,000. There were thirty-four other viaducts—all in wood—between Plymouth and Truro and eight between Truro and Falmouth. All the former and most of the latter have since been replaced in stone.

Amongst others of the little railways which went to the building up of the Great Western were the Great Western and Brentford—18 & 19 Vic., c. 191, 1855—which extended from Southall to docks to be built at Brentford. It was opened on July 18th, 1859, and transferred to the Great Western in 1865. The Worcester and Hereford was sanctioned by 16 & 17 Vic., c. 184, 1853. It was built to the standard gauge, but the Act provided that the mixed gauge should be laid down should an outlet be required from the South Wales Railway to the manufacturing districts. The Worcester and Hereford, along with the Newport, Abergavenny and Hereford and the Oxford, Worcester and Wolverhampton were amalgamated as the West Midland in 1860. The Carmarthen and Cardiganshire runs from Carmarthen to Aberystwyth and was completed in 1867.

The Vale of Llangollen was the first stage in railway communication from the Chester and Birkenhead to the Welsh Coast. It began at Ruabon and went to Llangollen, was sanctioned by 22 & 23 Vic., c. 64, 1859, opened December 1st, 1861, and amalgamated with the Great Western in 1896. The Llangollen and Corwen took the line to Corwen, whilst the Corwen and Bala carried the line to Bala and the Bala and Dolgelly took it to Dolgelly, where a junction was made in 1868 with the Aberystwyth and Welsh Coast Railway—later the Cambrian. The Severn Valley Railway was, as regards its length—40 miles—a big undertaking when compared with the lines now being noticed. It ran from Hartlebury on the Oxford, Worcester and Wolverhampton to Severn Valley Junction, Shrewsbury, and was opened throughout on February 1st, 1862. Amongst other smaller lines the Bourton-on-the-Water from the West Midland at Chipping Norton Junction to the town named, the West Somerset, which joined Watchet to the Bristol

* No. XV. appeared October 10th.

and Exeter at Norton Fitzwarren, the Wrexham and Minera, the Calne from Chippenham to Calne, and the Marlborough from Savernake to the town named, may be mentioned in passing as brought into service between 1862 and 1864.

Reference was made in our last article to the West London Railway and the West London Extension. The latter is the property of an independent company. It is owned as to one-third by the London and North-Western, one-third by the Great Western, one-sixth by the London and South-Western, and one-sixth by the London, Brighton and South Coast. It was sanctioned by 22 & 23 Vic., c. 134, 1859, and was opened to Clapham Junction on March 2nd, 1863. The Extension Railway took over the Kensington Canal and the railway was built upon it, but the outlet into the Thames was retained as a creek, and is still so used. The bridge over the Thames at Chelsea has six arches of 120ft. span each and seven of 25ft.

It is astonishing how many railways were inporated ultimately in the Great Western. Besides those already named we note the Pembroke and Tenby, acquired by the Great Western in 1897. The Bristol and South Wales Union which furnished an alternative to the long detour *viâ* Gloucester, was amalgamated with the Great Western in 1868. The Nantwich and Market Drayton was absorbed in 1897. The Faringdon branch, from Uffington to Faringdon, was transferred to the Great Western in 1873. Amongst other lines and companies the mere mention of their names is sufficient to show how much the Great Western absorbed. There were, for instance, the West Somerset Mineral Railway, the Weymouth and Portland, the Wallingford and Watlington, the Chard, the Stourbridge, the Bristol and Portishead, the Wellington and (Market) Drayton, the Buckfastleigh, Totnes and South Devon, the Lostwithiel and Fowey, the Newquay and Cornwall Junction, the Cheddar Valley and Yatton, the Ross and Monmouth, and the Bristol and North Somerset. This list does not exhaust the names, but it would be tedious to continue the enumeration.

On Christmas Eve of 1874 there occurred the worst accident on record for purely English railways, when thirty-four passengers were killed at Shipton-on-Chirwell as a result of a broken tire. The two coroner's juries attributed the failure to the abnormally severe weather. Colonel Yolland put the blame on the method of fastening the tire to the rim of the wheel—*i.e.*, by four countersunk rivets.

The Artificial Drying of Crops.

FARMERS have the reputation of being very conservative in regard to their methods, but the most obstinate agriculturist will be forced to admit that any method of harvesting which is independent of weather conditions will be a great boon. The subject of artificial drying came very much to the fore during 1918 when the food supplies of these islands were menaced by the enemy submarines, on the one hand, and, on the other hand, by a very rainy autumn, which made it very difficult for the farmers to gather in their crops. Again during 1923 experiments were conducted by the Ministry of Agriculture at various centres in an endeavour to determine the principles and to define the precise possibilities of drying hay and corn crops in stacks by artificial means. The system then employed consisted of building the stack round a hollow central structure through which air at atmospheric temperature was forced by a power-driven fan and distributed through the stack. This process was continued until all the surplus moisture was removed, and between the times of blowing, fermentation, owing to bacterial and other causes, was permitted to take place, the chemical action resulting in the heating of the stack. The cold air blown through the material was calculated to reduce the temperature again and to remove the moisture, but owing to the comparatively low absorptive properties of the cool air, the blowing had to be continued over a very long period of time, making the process too expensive and causing mould in the stack; the lower the temperature and the greater the atmospheric humidity the more inefficient did the system prove to be.

Profiting by these abortive experiments, the Institute of Agricultural Engineering at Oxford University—an institution which has only been in existence some six months—with the financial backing of the Board of Agriculture, has carried the experiments a stage further, with results that must be considered decidedly encouraging, and, from what we have seen, the Board of Agriculture is to be commended for taking the initiative in this direction, for the subject is one of prime national importance. If some practical system of drying cereal crops had been obtainable during the last two years, many hundreds of acres of ruined corn could have been saved by British farmers. The process and appliances which have been evolved by this new department of Oxford University are exceedingly simple, and comparatively safe, and the plant does not necessitate a very serious capital outlay.

Briefly, the process is as follows:—The crop is cut in the ordinary way, and if the weather conditions are favourable, is left out for a period of about twenty-four hours, during which time the crop gives up a considerable part of its moisture, thus rendering the subsequent artificial drying process easier. If, however, the weather is unfavourable, the crop may be carted immediately to the stack, where the drying process is prolonged. The principle utilised is the employment of air warmed by passage over a heated flue. The heat is provided by paraffin pressure burners. The warm air thus produced is blown by means of a fan into a conical central chamber, round which the stack is built. The chamber is made up of six timber supports, each about 3in. by 2in., which are covered by wire netting through which the air passes into and through the stack. The duct which connects the fan to the central structure may be made of metal of circular cross section, sufficiently strong to withstand the weight of material in the stack—about 150 lb. per square foot—and the duct is connected to the delivery branch of the fan by a flexible hose, the air pressure being only from 2in. to 4in. water gauge. The fan may be driven from any convenient source of power, such as a light tractor. The stacks should preferably be circular in form, and should contain from 10 to 25 tons of material. It is essential to the success of the process that the temperature of the air should not be above 100 deg. Fah. The time required for drying hay and cereals depends, of course, upon various factors, the chief of which are the amount of moisture in the crop dealt with and the amount of moisture in the air. Under ordinary conditions a stack containing excess moisture will gradually heat until a temperature of 120 deg. Fah. is reached. Then fermentation sets in, which causes a rapid rise to about 150 deg. Fah., a temperature that is sufficiently high to kill many of the bacteria that are responsible for the heating. At this point there is danger of another rapid rise in temperature owing to oxidation. The employment of heated air, however, tends to prevent this excessive rise in temperature, and so, it is claimed, fermentation and oxidation cannot take place.

A private demonstration of the process was given on Tuesday last, at which the visitors were able to witness the drying of a wheat stack and a stack composed of lucerne and rough grasses. They were also able to inspect stacks of barley and hay which had already been treated. The portable air heating plant comprises a curved circular flue made of fire-brick contained in a sheet iron chamber, the products of combustion passing through the flue and out into the atmosphere, while the cold air circulates round the flue, where it is raised in temperature about 40 deg. Fah., and is blown into the stack. With the exception of the power plant to drive the fan, the plant is therefore very inexpensive. Captain B. J. Owen, the Principal of the Institution, estimates the cost at about £50. The plant was delivering air at the estimated rate of 3500 cubic feet per minute at a pressure of 3in. water gauge, at a cost for fuel of 9d. per hour, while the fan required 4 horse-power to drive it. Time did not permit of witnessing the complete drying process, but we were informed that the minimum period required for a stack of 10 to 15 tons was about eight hours and upwards, depending upon the condition of the crop.

It is claimed that the rapid removal of the moisture prevents any chemical changes from taking place, and consequently no nutriment is lost, and it is further claimed that the crops so treated are at least as palatable as those dried naturally.

The Oxford process would appear to mark a decided step forward in this important subject, and we hope that the Institution will persevere in its experiments. The chief difficulties that would seem to require tackling are those of temperature and time. Provided the temperature never becomes excessive, over-drying should scarcely be possible, but insufficient drying and overheating may be a troublesome factor in the hands of unskilled farm servants. In drying grain crops, it is certain that the straw will dry before the ear, in which case, when the crop comes to the thrashing machine, the results will be unsatisfactory. A sample of barley which we examined seemed to have suffered from this cause. It may also be found necessary in very damp weather to devise some means to dry the air before it is forced into the stack, which will add materially to the plant employed.

The following figures relative to the cost per ton of hay were supplied by the Institution:—

In a Good Season.

	Artificial method.	Ordinary method.
	s. d.	s. d.
Cutting	3 0	3 0
Carting and stacking	7 0	6 0
Making	—	4 6
Artificial drying	1 6	—
	11 6	13 6

In a Bad Season.

	Artificial method.	Ordinary method.
	s. d.	s. d.
Cutting	3 0	3 0
Carting and stacking	7 0	6 0
Artificial drying	1 6	—
Making	—	9 0
	11 6	18 0

The figures supplied were actually collected during the present season, but it is recognised that they are subject to variation, owing to different conditions. In cases where crops have an excessive moisture content, the cost of carting and stacking may be higher.

Literature.

SHORT NOTICES.

Cosgrove's Handbook of Woodworking Machinery. The Cosgrove Company, Michigan, and *Timber Trades Journal.* London. 1924. Price £3 2s. 6d.—It is a little difficult to say how this book should be classed; it is not a text-book and yet it is not a catalogue. Possibly the best description of it would be a "user's guide." We are told in the preface that "The idea of the publishers has been to furnish in compact, readily accessible form, a comprehensive survey of the product of all the builders of woodworking equipment in the United States, and to keep that survey accurate and up to date by issuing at frequent intervals inserts covering new machines." The work, carried out under the supervision of Mr. George F. Cosgrove, has been very well done. It is arranged alphabetically, and under each heading is given the names of the makers of the appropriate class of machines and the general characteristics and uses of those machines. Much ability in the condensation of descriptions has been exercised. With the part issued there are no illustrations, but we understand that as new "inserts" are issued, illustrations will be provided. There are something over 1000 headings, and an extensive index. All the pages are "loose," but they are bound in a firm loose leaf binder, which permits of the introduction of supplementary pages as they appear.

An Introduction to the Strowger System of Automatic Telephony. By H. H. Harrison. London: Longmans, Green and Co. 1924. Price 7s. 6d. net.—The recent announcement by the Postmaster-General that the names of several London exchanges were being altered to meet the requirements of the automatic telephone system, which is to be introduced stage by stage in London, makes the appearance of this little volume very timely. In it the Strowger system, the system, it is understood, which will be used in London, is fully described. It is not probable that the general reader will ever follow the details of any automatic telephone system, but a volume of this kind is certainly needed for the instruction of students and others who are studying telephony. It concludes with a few remarks about the Director, which is the key to the use of automatic telephony in multi-office areas, and which is essential during the transition period from manual to automatic. Mr. Harrison's last words are: "The director system has itself effected a fundamental change in methods of operation; and while the mechanisms will probably remain as we know them to-day, the continual demand for fresh facilities and the rapid expansion in the adoption of automatic systems all the world over, will be bound to lead to profound modifications and improvements." The book is illustrated throughout by diagrams and sketches.

Ice-cream Plant and Manufacture. By Robert G. Reid. London: A. J. Rayment. 1924. Price 10s.—We may suppose that few of our readers think of ice-cream seriously, either in the gastronomic or industrial aspect. Yet it seems that it is something to be seriously reckoned with, for in America—which in this matter leaves us far behind—there existed in 1922 plant to the value of 227,500,000 dollars, and at least 60,000 persons, with a wage and salary bill of 173,000,000 dollars, were employed in the industry. Even in London, Mr. Reid tells us, there is one firm that turns out no less than 20,000 gallons of ice-cream per day. Such figures as these leave us in no doubt that ice-cream deserves a text-book, and Mr. Reid's little volume, which he admits only touches the fringe of the subject, will serve well until someone with equal knowledge and more time produces a more important work. In it, he describes the plant and machines employed, and gives an interesting chapter on the lay-out of an ice-cream factory. Some of the illustrations give an excellent idea of the nature of these factories, and convey an impression of cleanliness and wholesomeness which is not always associated in the public mind with the subject.

Standard Methods of Testing Petroleum and its Products. Published by the Institution of Petroleum Technologists. 1924. Price 6s. net.—This little volume is the outcome of work done by a group of sub-committees which were appointed by the Institution of Petroleum Technologists as the result of a suggestion made by the late Sir Boverton Redwood in 1917. It covers all the important tests—gasoline, white spirit, kerosene, gas oil, mineral lubricating oils, transformer oils, fuel oils, asphalts, wax and crude petroleum—but omits a few of minor consequence. Not only are methods of testing defined, but the apparatus to be employed in making them is also standardised. It is pretty generally known that after due consideration the British Engineering Standards Association decided to adopt the work of the Institution, and that the standards detailed in this volume have received its imprimatur. They must therefore be regarded as the national standard tests. We suggest that in future issues the Institution should see that the title of the volume is printed on the back of the binding.

British Oil Engines: A Practical Handbook for Attendants, Erectors and Purchasers. By W. A. TOOKEY. London: Percival Marshall and Co. 1924. Price 2s. 6d.—Mr. Tookey tells us in his preface that his little book—it slips easily into the pocket—has been written primarily for the man who knows little or nothing about oil engines, but who desires to obtain impartial and reliable information in non-technical language. Mr. Tookey provides the reader of that kind with just what he wants. He has a very wide experience of oil engines, and he draws upon it freely for his remarks, never, as far as we can see, doing as authors are known to do, drawing information, not always correct, from other people's text-books. The little volume is one that can be safely commended to all who have oil engines in their care.

Locomotive Coaling Installation at Nine Elms.

By GEORGE FREDERICK ZIMMER, A.M. Inst. C.E.

At the time when the first self-contained locomotive coaling plant was installed at the locomotive depôt at Crewe, in 1911—the late Mr. C. J. Bowen Cooke designed the plant in conjunction with Babcock and Wilcox—the time had hardly come for such an installation in this country, because manual labour was then reliable, plentiful and inexpensive. It is therefore little to be wondered at that the Crewe plant remained the only one of its kind for about four years.

Since the war, conditions have changed very considerably, so that with the present cost of manual labour and its unreliability, mechanical coaling of locomotives shows an economy out of all proportion to manual coaling. In consequence, about a dozen installations have been erected during the last thirteen years, including one at Nine Elms. Particulars of the most important of these plants are tabulated below.

Table Giving Data Concerning the Most Important Locomotive Coaling Installations in this Country.

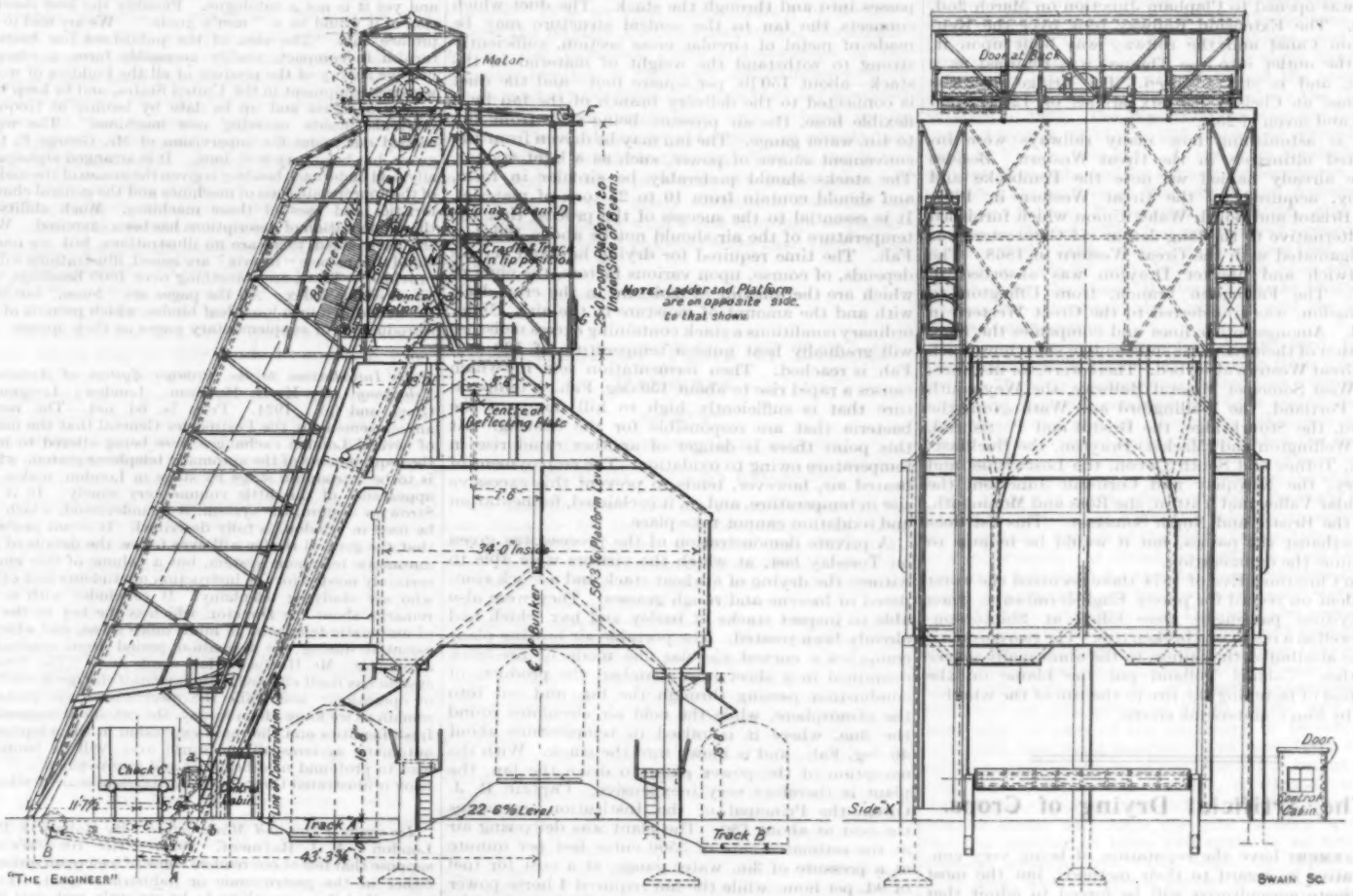
Name of plant.	Number of men required.	Overhead bunkers. Total capacity in tons.	Overhead bunkers. Number and nature.	Locos. coaled per day or at a time.	Type of tippler.	Method of feeding bunkers.	Date of erection.
Crewe Installation, No. 1, L. and N.W. Rly.	5 by day, 1 by night	300	Two steel	140 to 150 per day	Rotating	Tip tray conveyor	December, 1912
Edge Hill, Liverpool, L. and N.W. Rly.	—	120	Three ferro-concrete	6 at a time	None	By gravity from overhead rail track	1913
Dairycoates, Hull, N.E. Rly.	—	300	Two steel	135 per day	End tip with overhead lifting gear	Tray type conveyor	1916
Stratford, G.E. Rly. ..	—	800	Ferro-concrete	300 to 400 per day	Rotating tippler	Band conveyor	1922
Crewe Installation, No. 2, L. and N.W. Rly.	—	250	Ferro-concrete	—	Railway trucks operated by Mitchell's truck hoist	Lifted vertically into top of bunker	1922
Feltham, near Twickenham, L.S.W. Rly.	—	—	Ferro-concrete	—	Ditto	—	1921
Nine Elms, Southern Rly.	—	400	One ferro-concrete	—	Ditto	Lifted up inclined path into bunker	July, 1924

There are, generally speaking, two main classes of locomotive coaling installation, i.e., with or without overhead bunkers. The first type is the better, and should be installed at all important coal yards, while the other, which conveys the required amount of coal to each engine individually, is only justified when there is insufficient traffic and lack of space for the larger type of plant. In the former type the bunkers are generally of a size sufficient for dealing with the engines which have to be coaled during the night. This plan avoids having to employ men to work the mechanical portions of the plant, operate capstans, shunt, &c., during the two eight-hour shifts which break into the hours of darkness. The advantage is obvious. The installation here described belongs to this category.

The methods of conveying coal to the bunkers vary very materially in different plants, both intermittent and continuous handling devices being in use. Whatever may be said in favour of, or against, intermittent handling methods, experience gained with existing locomotive coaling installations, in which the whole coal wagon is lifted bodily, points conclusively to the fact that in the vast majority of cases the intermittent method is to be given the preference. With this system there is less breakage of coal, less expense for driving power, while in most cases costly excavation is eliminated, with its inherent necessity of keeping out water.

Nowadays locomotive coaling plant is mostly operated either by skip—the method favoured in America—or by raising the full coal wagons bodily and emptying them into an overhead bunker—the method favoured in this country. There are eight locomotive coaling installations in this country with overhead bunkers in use; in all the earlier installations the coal was raised by intermittent conveyors, while of the remaining plants, all of which have been installed since 1919, the coal trucks are, with but one exception, raised bodily, and their contents dumped into the bunkers. These installations have been tabulated for ready reference in the accompanying table.

Owing to the space available in locomotive yards being generally confined, and owing also to the relative position of the rail tracks on which the coal arrives and those on which the locomotives are coaled, hardly any two coaling plants are alike. That at Nine Elms, designed and executed for the Southern Railway Company by the Mitchell Conveyor and Transporter Company, Limited, is not only the very latest, but also the largest example. It is illustrated by side and end elevation—Figs. 1 and 2—and by two photographic views—Figs. 3 and 4—of which one is a general view, whilst the other shows a full truck in position ready to be raised. Any size of standard wagon, having a capacity of from 8 to 20 tons of coal, can be handled by this plant, the usual sizes at present dealt with being 10 to 12-ton trucks, but in the near future 20-ton trucks will, it is expected, be dealt with. The coal trains are made up as follows:—The first, fifth, ninth and thirteenth truck contain the same variety of coal, and similarly the second, sixth, tenth and fourteenth, and so on; so that four different varieties are employed. Owing to this arrangement, the fuel is stratified in the bunker, and when withdrawing it on to the locomotives it becomes automatically mixed. The trucks are marshalled on the full and empty sidings, either by a shunting engine or by electric capstans.



FIGS. 1 AND 2—LOCOMOTIVE COALING PLANT AT NINE ELMS

The coal arrives at the siding on the left—see Fig. 1—which passes through the plant structure between the ferro-concrete bunker and the sloping mild steel structure. The locomotives are coaled on tracks A and B. A shallow pit is provided so that the cradle on which the trucks are raised obliquely can be lowered so far below rail level that in its lowest position the rails of the siding and those on the cradle are continuous right through. In this position a full wagon is pushed on to the cradle, and after the brake has been applied it is ready for lifting. The cradle is cantilevered from its carriage, which runs on two pairs of wheels *a* and *b* on two inclined tracks of I section. Parallel with these tracks is a similar pair of girders which serve as retaining rails. Cradle and carriage, during the lifting operation, rest in a bight of two hauling ropes which pass over two pairs of rope wheels A and B on the cradle. While the cradle and its carriage are a rigidly connected structure, that portion which carries the standard rail track and with it the coal truck, is connected to the main body of the cradle by a pair of trunnions *c*, which are slightly out of the centre line; in fact, there is a cradle within a cradle, the inner one having a bias to drop slightly towards the bunker structure. In the initial position the upper surface of both the inner and outer cradles form one level plane, but the inner cradle is retained in that position by a stationary support beneath in the pit. As soon therefore as the cradle begins to rise, it leaves this support and the inner cradle tilts, causing the wagon to lean against

a chock C, which, being covered with hemp rope, forms a perfect support, and accommodates itself to all unevennesses of the truck.

Hoisting.—As the two winding gears near the top of the structure continue to wind in the wire ropes, the bight in which the cradle floats becomes shorter and the cradle slowly ascends, till its tipping position is reached. At this point the rail track describes a backward curve, which brings the track wheel *a* into

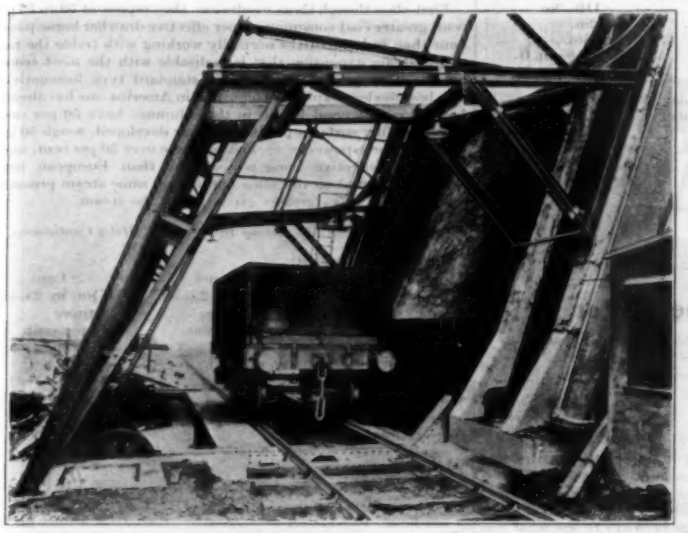


FIG. 3—TRUCK READY TO BE RAISED

the fulcrum round which the cradle rotates, and causes the truck wheels *b* to disengage. Further shortening of the ropes now rotates the cradle through an angle of approximately 90 deg., during which the wagon rests securely on the chock C. At this point the top of the wagon encounters the retaining beam D, which is so weighted by two kentledges that the weight of the wagon is securely held against the cradle by the two kentledges to support it for the rest of the rotation of the cradle and wagon until eventually an angle of 140 deg. has been reached, when the wagon empties itself completely. During the latter stages of tipping the bights in the ropes gradually disappear, and their function changes now from a lifting one to a pushing one. This action continues until the cradle has passed through an angle of a little more than 90 deg., when it would fall over to the bunker side if it were not prevented by the ropes which hold it in check whilst passing its dead centre, and also by the retaining beam D. The cradle in its tipping position is shown on the drawing in dotted lines. In that position the hoisting ropes, which are still in contact with the rope wheels A and B, pass from the swivelling point X over wheel A, thence over wheel B and back on to the drums.

Although this tipping process is extremely simple, yet, in order to render the above description more lucid, the whole process is once more summarised in different words. As soon as the cradle leaves its initial position on terra firma, the coal truck rests gently against chock C; during the early stages of tipping this chock practically takes the full weight of the wagon. As the rotation of the wagon proceeds beyond its now horizontal position, it is necessary to secure it on the cradle by the retaining beam, which gradually takes an increasing share of the weight until in the final tipping position the weight is equally supported by both chock C and retaining beam D. During the return of the empty wagon to the initial position, all the operations enumerated are reversed.

Chock C.—The chock on the cradle rests in two trunnions at the two extreme ends so that it can move and adjust itself to the position of the truck. This chock is connected by levers which produce a parallel motion between it and the inner cradle, thus when the truck stands in its normal upright position the chock is parallel to the side of the truck; as soon, however, as lifting begins and the truck commences to slant sideways the chock simultaneously assumes the same slope as the truck side. And when the empty cradle returns to its initial position and as it rights itself the chock automatically returns to its rightful position, so that by the time the truck touches the chock it does so uniformly along the whole of its surface.

The Retaining Beam D is a wood-lined steel beam of a length exceeding that of the wagon by several feet, and its normal position is such that it engages with the centre line of the wagon when tipping. The beam is retained in its normal position by two chains which pass over wheels E and F and eventually are continued by wire ropes on to the two kentledges G, which are seen outside the structure on the photographic view—Fig. 4. In order to hold the retaining beam D securely in its proper position, it is anchored by two steel arms H, which also have their fulcrum at point X. These steel arms H are far enough apart to permit a 20-ton coal wagon on the cradle to pass between them.

The Bunker which holds 400 tons of coal is of such a design that it fills completely without trimming. It is divided longitudinally into two compartments, each of which is capable of storing 200 tons of coal—sufficient for a period of 24 hours. At the top of the bunker is a wide deflecting plate for the purpose of directing the coal from the trucks into one or other of the two bunker divisions. This plate is secured to a square shaft which projects beyond the structure on each side, where it is provided with a balance weight. This plate can be operated by ropes from the driver's cabin, but is at present worked by a small winch on the high level platform. The swivelling point of this deflecting plate is marked on the side elevation.

The hoppered portions of the bunker are breeches shape and divide the bunker outlets into four groups of loading shoots, two in each, so that engines can be coaled on two roads, as shown on the side elevation. These shoots are provided so that, if it is desirable, two different kinds of coal can be supplied to each locomotive; at the present moment, however, the same mixture of coal is delivered from each shoot. The shoots are calibrated and provided with two Simplex valves—the upper one for admitting the coal into the shoot and the lower one for releasing it on to the tender. The space between the upper and lower valves provides accommodation for half a ton of coal. One of the outlets of each group is narrowed down so that coal can be delivered more conveniently on to tank engines.

The Hoisting Gear with its motor is placed in a separate housing at the very top of the main structure, and is supported by the two central vertical members which rest on the concrete bunker. A 24 horse-power electric motor is secured in a central position in the cabin. Power is transmitted by an intermediate countershaft and two pairs of spur wheels on to one long countershaft which is geared by two pinions on to the two spur sheels which form part of the two winding drums, one at each side, as may be seen in the end elevation. The extended spindle of the motor is provided with two solenoid brakes operated by limit switches. The hoisting drums for the cradle are about 4ft. in diameter and built together with two slightly smaller drums which manipulate the balance weights which account for the cradle, the empty truck, and about half the load. The two separate hoisting ropes are secured at the end to the two hoisting drums while their other ends are secured by a swivelling anchorage at point X, round which the cradle rotates when tipping. In this way the ropes form a double bight in which the cradle floats on its two pairs of rope sheaves A and B. The two ropes which manipulate the balance weight are similarly connected to the two smaller drums.

Owing to the fact that the trucks and their loads vary from time to time the balance weights are so arranged that additional weight units can be inserted when necessary. The arrangement of the balance weights is ingenious. The method followed may be understood from the two elevations—Figs. 1 and 2. The path of the weights being shorter than that of the cradle accounts for the difference in the diameter of the drums. The weights are assembled on two bogies which are lashed together and which travel on inclined paths on suitable tracks on the extreme outsides of the structure. These paths flatten near their lower extremities by a curve into a very slightly oblique path, so that as the cradle completes its lift and the tipping begins the weight on the ropes becomes gradually less, since the two weighted bogies change their direction from a steep incline to a shallow one.

The Steel Superstructure rests on the concrete bunker structure and terminates in the superimposed winch cabin. The wagon hoist and winding gear are covered in with corrugated asbestos sheeting mounted on a steelwork framing, for the purpose of protecting the machinery and the workers from the weather. Both concrete and steel structures are of substantial dimensions, the latter being constructed of rolled steel sections, strongly braced together. All parts of the structure are accessible by iron ladders fitted with handrails.

Operating Cabin.—The control cabin is situated on the ground level and close to the spot on which the trucks enter the cradle. The controller used is of the tramway type. In addition to the attendant in the control cabin the following are also necessary:—

One (or two) men on coaling platform to operate shoot valves (on each shift). One man to shunt wagons and work hoist (one shift only). One man on the top to break coal through grid (one shift only), since the Southern Railway buy exceptionally large coal, otherwise this man would ot be necessary.

Power Consumption.—The only motor in connection with this plant is of special design, supplied by Electromotors, Limited, to suit the particular conditions. It is nominally of 30 horse-power. It must

FIG. 4—LOCOMOTIVE COALING PLANT—GENERAL VIEW

be taken into consideration that it takes only three minutes to lift and empty a truck. If it is assumed that the average contents of the wagon are only 10 tons, it would take 40 wagon loads to fill the bunker with 400 tons. The actual running time of the motor is thus only about two hours out of the twenty-four; the current consumption is, therefore, small as compared with other systems in which the conveying devices are constantly running.

Conclusion.—We know from experience that with manual coaling the cost of transferring one ton of coal to a locomotive tender is 9d. With the plant here described it is only about 4d., where interest on capital outlay is charged at 5 per cent., depreciation at 5 per cent., and cost of current, attendance and maintenance are included, while a life of thirty years is allowed for. In addition to the above saving in wages further economy accrues from the rapidity with which the engines can be coaled, since the time occupied in placing 8 tons of coal into a tender is less than 2 minutes.

THE NEWCOMEN SOCIETY.

The Newcomen Society opened the 1924–25 session on Wednesday, October 8th, with a meeting at the Iron and Steel Institute, when three papers on the early days of ironmaking in Shropshire were presented and discussed. One of these, already reprinted in our columns, see The Engineer of June 20th, 1924—was read originally at Shrewsbury by Mr. Rhys Jenkins when the Society held its summer meeting there. Another paper was read by Mr. J. W. Hall, and the third was presented by a visitor, Mr. T. S. Ashton, of Manchester University. After carefully reviewing all the evidence available, which, it was admitted was not conclusive, it was held that to the elder Darby must be ascribed the honour of first smelting iron with coke in 1713 or thereabouts. An interesting point which turned up in the discussion was why some forty years elapsed before coke-iron displaced charcoal iron. Some speakers thought it was due to the absence of a market for cast iron articles, but since it was admitted that once the method was adopted it made rapid strides, that view met with some opposition. A remarkable feature of the evening was the unanimity with which all the expert speakers agreed with Mr. Ashton that Dud Dudley's claims to have smelted iron with pit coal in 1620 were very thin indeed. They all seemed to have reached the same conclusion that he was of an "assertive and untrustworthy disposition," and that he did nothing to merit the esteem in which he has been generally held.

EXHIBITIONS.*

"I am strongly of opinion that the holding of industrial exhibitions at which our manufactures and our methods of production are shown in great detail has been overdone. There are many things which can be said in favour of such exhibitions, and nearly every manufacturing concern in this country has at one time or another shown its productions at the many exhibitions, great and small, which have been held at various places throughout our land. I ask you carefully to consider, however, whether in doing so we do not lay ourselves open to the danger of giving away to our foreign competitors something which may be really vital to our prosperity, or even indeed to our very existence. The very first and most famous exhibition ever held in our land, that of the year 1851, in the great Crystal Palace in Hyde Park—the building which is still in existence at Sydenham—was, of course, long before our time, but I do know that some of our fathers held the opinion that that great and novel show of Great Britain's manufactures and methods was promoted primarily—possibly innocently enough—by the German influence then predominant in our Royal Family to show the Germans the source of this country's prosperity, and to give them a pointer as to how to go and do likewise. It is from that date that we may count the commencement of our troubles and misfortunes through the gradual loss of our trade and manufactures to the Germans and other foreigners, with the consequent bitter rivalries, jealousies, and ill feeling generated by fierce competition, which this country by its fiscal policy has been unable adequately to meet. This state of affairs without doubt culminated in the Great War with all its tragic consequences.

"You may possibly consider that this notion is of a somewhat far-fetched nature, but I venture to say that there is a precedent for it in actual history, and those of you who care to read the twentieth chapter of the Second Book of Kings will there find the account of a somewhat similar occurrence and its disastrous results. I can only say that I make these observations in all sincerity, and I respectfully suggest that we should at least weigh well all the possibilities before we show competitors our trade secrets and details, merely for the sake of making a parade of our resources or as a supposed advertisement."

NEW "GARRATT" TYPE ENGINE FOR SOUTH AFRICAN RAILWAYS.

An order for one fast passenger engine, of "Garratt" type, was recently placed by the Railway Administration of the Union of South Africa with Messrs. Beyer, Peacock and Co., of Manchester. This locomotive is designed for main line fast passenger service, and will be of the 2–6–2, 2–6–2 type, with a coupled wheel axle load of approximately 15¼ tons. Equipped with superheater and Walschaerts' valve gear, the construction throughout is of approved modern locomotive practice. The advent of this style of passenger engine on the South African Railways will be watched with great interest, especially as regards its capabilities and performance when operating such a train as the Union Limited Express between Johannesburg and Cape Town.

The leading dimensions will be as follows:—

Bissel and carrier wheel	2ft. 6in. dia.
Coupled wheels	4ft. 9in. dia.
Cylinders	1ft. 6in. dia.
Cylinders' stroke	2ft. 2in. dia.
Boiler pressure	180 lb. per sq. in.
Boiler diameter at first ring (inside)	6ft. 9in.
Boiler length of barrel	11ft. 3in.
Tubes 288, outside diameter	2in.
Tubes 36, outside diameter	5½in.
Grate area	57.65 sq. ft.
Total engine wheel base	68ft. 4in.
Total fixed wheel base	10ft.
Height rail level to top of chimney	12ft. 10in.
Approximate heating surface (tubes)	2307 sq. ft.
Heating surface (fire-box)	211.3 sq. ft.
Total heating surface	2578 sq. ft.
Superheater area	440 sq. ft.
Total water capacity	4600 gallons.
Total coal capacity	10 tons.
Tractive force at 75 per cent. boiler pressure	39,902 lb.

* From Mr. J. Howden Hume's presidential address to the Institution of Engineers and Shipbuilders in Scotland, October 14th, 1924.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

CHEAP POWER ON RAILWAYS.

Sir,—At the World Power Conference the economical results given by what are very generally reputed to be the most perfect and economical of modern steam locomotives, were published to the world by the chief mechanical engineer of the Great Western Railway; these results are now being very much quoted, for they are enabling foreign railways to see what can be accomplished by the most up-to-date improvements in the steam locomotive, before going too far with the "gazification" of railways, which promises eventually to render railway travelling as hygienic as that with which we are already familiar in omnibuses and char-à-bancs.

These Great Western locomotives are designed with an exceptionally long valve travel, 8¼in. maximum, I believe, in reducing the compression period, and therefore adding as considerably to the area of the card (and consequently to the horse-power at any given cut-off), as realised by continental applications of two separate exhaust valves run by trip gears, Corliss gears and by other such combinations known in stationary engine practice. The addition is at the heel of the card, and therefore of much more value than the slight addition to the cut-off pressure by trip gears. This valuable feature, which dispenses with stationary engine trip gears, was, I understand, introduced, against some opposition, by Mr. Churchward. When it is mentioned to locomotive engineers of other railways, it causes no little astonishment; but this 8¼in. travel is also used for much shorter piston strokes by the French P.L.M. Railways, with an enormous power increase at high speeds. With this improvement, one naturally expects better results on the Great Western Railway, even in disregarding the unprecedentedly high rates of evaporation with the Great Western Railway coal, and of which no parallel exists anywhere.

"Castle" Class Express Locomotives, Great Western Railway. Dynamometer Tests of Caldicott Castle.

Coal used for preparing fire not weighed, but same quantity of coal left on the grate at trip end as at the start off. Coal consumed, 6 tons 10 cwt. 19 lb. during trip. Boiler pressure 225 lb. per square inch.

Water evaporated per pound of coal consumed	12.2 lb.
B.Th.U. per pound coal	14,780 B.Th.U.
Water per I.H.P. hour	20.9
Water per drawbar H.P. hour	28.1
Coal per I.H.P. hour	2.1
Coal per drawbar H.P. hour	2.83
Mechanical efficiency, 2.1 ÷ 2.83	= 0.74
Average drawbar H.P. from coal, pounds	14,579 ÷ 2.83 = 515
Average indicated H.P. from coal, pounds	14,579 ÷ 2.1 = 694
Average indicated H.P. per ton of engine loaded	9 I.H.P.
Maximum pull at drawbar at 71 miles per hour	2.35 tons
Character of profile: London–Plymouth; Express train loads about 450–460 tons	

The excellence of the long valve travel is shown by the exceptionally large card areas obtained when the engine begins to move in full gear with full throttle = 92.6 per cent. of boiler pressure inside cylinders, and 93.6 per cent. of boiler pressure outside cylinders. Such percentages are only usual in engines cutting off at 92 per cent. of the stroke.

It is to be noted that these results are from road tests. Lower figures are frequently quoted by the United States railway journals; but when traced to their source they are found to have been derived originally from locomotives anchored in the warm testing shed, running at constant speed—that, too, at 170 revolutions per minute—which revolutions per minute gives the greatest horse-power for a given cut-off, and with a cut-off not lower than 30 per cent. or higher than 35 per cent. (or 40 per cent. in freight engines). The lower the cut-off, beneath 30 per cent., and the higher the speed, the greater the steam consumptions per horse-power hour. In this way the calculated steam rate passing through the cylinders, not of all losses elsewhere, has been—quite exceptionally—as low as 16.5 lb. per indicated horse-power hour, and such figures when shuffled with road tests have a way of being quoted as road tests. The shed testing plant is of very great value in "tuning-up" locomotives and in showing certain facts not obtainable on the road—as when running for two hours at constant cut-off and constant speed—but the use of figures thus obtained for commercial advertising purposes is to be deprecated, because they awaken suspicion in those who know from long practice that the modern standard superheated steam locomotive in actual road working on average hilly roads, with a load that pays the railway company, never does reach average consumptions much below 20 lb. superheated steam per indicated horse-power hour and 31.5 per horse-power hour at the dynamometer.

This has been shown by some hundreds of tests in continental Europe with the best-class modern superheater locomotives; and from an American engineer, expert in these matters, we learn that it is the very best result obtained in road service in the United States of America. Further, American modern locomotives exported to Europe all give this as the best result, under easy conditions, where the cut-off of 33 per cent. need not be exceeded, and where a capable driver takes care to use the throttle rather than the reverse gear for lower power requirements.

First-class though these results are, they represent 50 to 53 per cent. greater coal consumption per effective drawbar horse-power hour than in locomotives normally working with treble the rate of the steam expansion that is realisable with the most economical cut-off possible in ordinary standard type locomotives. The best modern express locomotives in America—as has already been shown at great length in the columns—have 50 per cent. larger heating surfaces per horse-power developed, weigh 50 per cent. per horse-power more, and consume over 50 per cent. more steam per effective horse-power hour than European locomotives operated on the same cut-off and same steam pressure, but with 2.8 times greater expansion of the steam.

Line Profile: Bank, rising 1060ft. in 82 Miles Continuous.

	(Four) 19in. by 25.5in.	(Two) 17½in. by 25.5in.
Cylinders supplied with live steam		
Average steam expansion	2.5 times	6 times
Cut-off average	40 per cent.	50 per cent.
Car train load	487 tons	645 tons
Average speed	57 m.p.h.	55 m.p.h.
Water per I.H.P. hour	20.5 lb.	14.2 lb.
Water per drawbar H.P. hour	32.5 lb	20.4 lb.
Average mechanical efficiency	0.60	0.70
I.H.P. average, per ton of loaded engine	20 I.H.P.	23 I.H.P.
Drawbar pull at 70 miles per hour	—	3.5 tons (at 75 m.p.h. 3 tons)
Coal evaporating 12.2 lb. water per pound of coal, per drawbar H.P. hour	2.86 lb.	1.67 lb.

The expansion rate, as increased nearly 2½ times, with an increased cut-off, in the above example, enables 53 per cent. greater work to be done at train head per ton of coal consumed. Long cut-offs favour free running with minimum negative indicated horse-powers. The performance in Col. 1 is exceptionally good for the type—from The Engineer, page 509, June 8th, 1916.

It is therefore purely a question of choice that some railways positively prefer to consume 1½ million tons of coal where 1 million would suffice for the same work done—by trebling the rate of the steam's expansion. Perkins laboured to explain this, and his colleagues of the Institution of Civil Engineers in 1836, from brake tests of uniflow engines, but the fact still remains, as then, little understood.

The British locomotives, which are considered by the authorities, although never claimed officially as such, to be now the most efficient engines in this country, are nominally of this improved system; but, unfortunately for the realisation of much coal saving, they are fitted with only one high-pressure cylinder of about 19in. by 26in., as against two considerably larger high-pressure cylinders, served by the same-sized boiler, in the standard engines. Hence it is quite impossible to operate that one small cylinder at a cut-off which would, with equal loads, enable the engine to work with a trebled rate of expansion, and by which alone such coal economy as named is realisable. Nevertheless, these little (claret-coloured) locomotives may be known miles away across the country by the inhabitants by their high speeds and, for the grades, long trains, as also the peculiar exhaust, with steam which barely rises from the chimney, even on up grades. With an extra 19in. by 26in. cylinder, without changing the high-pressure: low-pressure ratio, and for which there is ample room and to spare, these fine engines would undoubtedly save 33 per cent. of the coal where they now only save somewhere about 15 per cent., and their haulage power would be very much greater.

As to their working, the drivers are delighted with them, for they beat all others in speeds and loads; but some drivers will be found who prefer the older, and "higher," ones, using saturated steam. Lord Monkswell and others write highly of their capacity; but it is remarkable that so many people should have the very peculiar idea that these high speeds are only obtained by using twice the cut-off in the low-pressure that is given in the high-pressure—that being the absolutely certain way of reducing the coal economy, the M.E.P., the indicated horse-power and the tractive efforts, and therefore the speeds. Quite the contrary, these engines are run with much shorter low-pressure cut-offs, precisely in order to augment the power of the low-pressure cylinders, and also the total power of the locomotive. Further, power in steam is a function of its density, as Perkins demonstrated with 3000 deg. superheat so convincingly in 1827, so that where the density is decreased by superheating, so its expansive rate is also reduced. Consequently, to enable it to develop a tonnage on the low-pressure pistons approximating to that of saturated steam, the low-pressure cut-off in the engines with superheaters is made much shorter, the relative high-pressure volumetric admission being increased by about 15 per cent. over the low-pressure in thus promoting a more equal subdivision of the work. The distribution on the cards is wonderfully symmetrical, and it seems a pity that, with such obviously capable designing, the steam rate per hour was not decreased by using the live steam in cylinders equal in volume to the standard type locomotives with the same boilers. A trip to the Midlands with these engines shows the smartest working, per ton of engine, so far realised—taking the profile of the line into consideration—and travel luxury by this line surpasses any in Europe.

October 11th. Charles R. King.

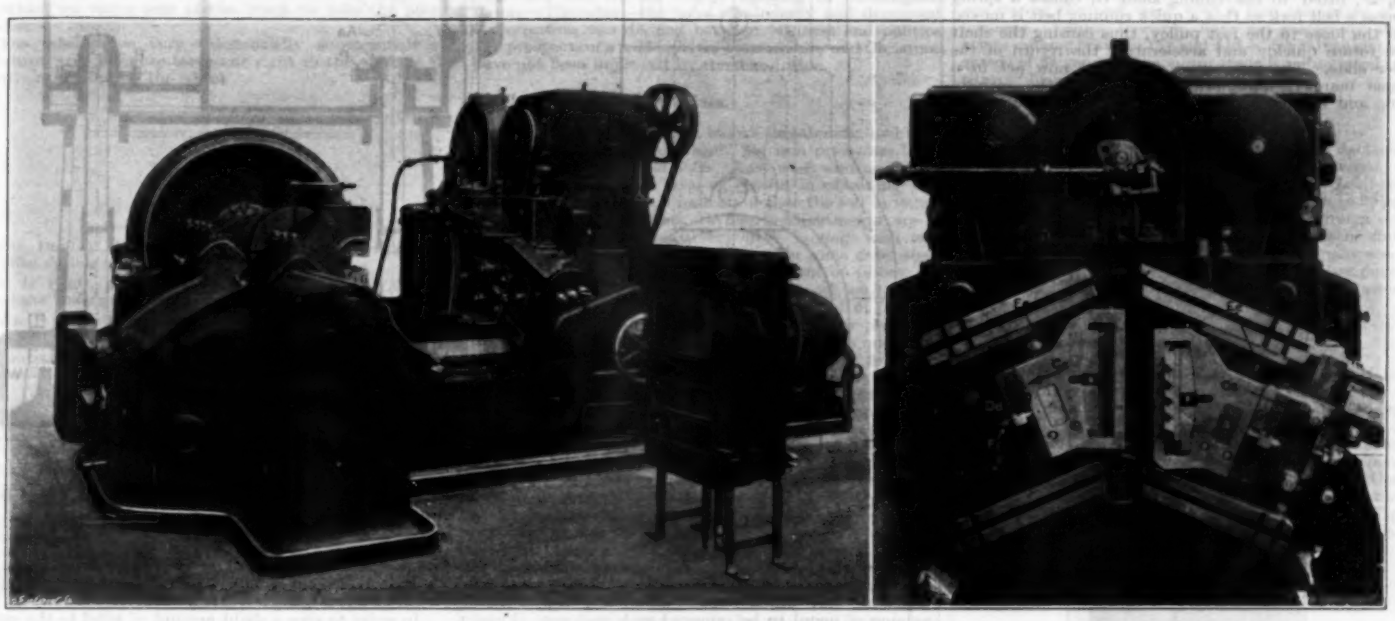
The bad weather has, according to the *Ironmonger*, caused the Scottish farmers to return to the use of old-fashioned hand implements in place of modern machinery. Ancient hooks and scythes, wielded mostly by Irishmen and women, are found more serviceable in reaping crops battered and flattened by rain and wind than binders.

A New Double Helical Gear Generator.

AN improved machine for cutting double helical gear wheels by the generating process has been designed and built by David Brown and Sons, Limited, Huddersfield, in whose works we recently had an opportunity of inspecting it in operation. It has a capacity for cutting gears up to 6ft. diameter, with 12in. face and 2in. pitch. The illustrations—Figs. 1, 2 and 3, on this page—show that in some respects it resembles a previous tool made by the same firm, but on going further into details it will be found that there are very important and fundamental differences in design and construction which enable the users to obtain more perfect work in a shorter space of time. It will be observed, first of all, that two generating cutters, similar to that shown in Fig. 4, are employed, one for each helix, right and left-hand. These cutters are made in the form of a rack, and are caused to reciprocate in the direction of their respective helices, cutting completely to the apex while the saddle slide is moving downwards. Advantages claimed for this kind of cutter are, the high degree of precision with which it can be made, and simplicity of the sharpening process, which is effected without changing the form of the teeth, any original distortion being corrected by grinding after hardening.

The cycle of operations is as follows:—A saddle slide which carries two reciprocating rack cutters travels vertically downwards tangentially with the pitch line of the blank which is being operated upon, whilst the latter rotates simultaneously in a clock-wise direction at the correct relative speed. When the saddle slide has moved vertically downwards through a distance equal to one or more times the pitch the rotation of the gear blank is arrested, as is also the reciprocating motion of the cutters. The saddle slide is then returned at an accelerated speed to its starting position, whilst the blank and cutters remain stationary, the latter being at the outer end of the stroke and clear of the blank. These operations are repeated until the first cut round the gear wheel is completed, when an automatic in-feed motion comes into operation, putting on depth of cut which is determined when setting up the machine. Simultaneously with the in-feed motion, movement is given to the saddle slide causing the feed to take place tangentially to one side of the rack tooth instead of directly towards the centre of the blank, in order to reduce—to a minimum—the torsion of the spindle which carries the blank, and minimise the pressure between the dividing wheel and its mating worm.

Referring to the drawings, the main driving shaft A—see Figs. 3 and 8—is coupled direct to an electric motor, speed changes being provided by means of the gear wheels B. By means of bevel gears motion is transmitted to a vertical shaft C—Fig. 3—which in turn drives two connecting-rods through a worm wheel carrying a crank pin D, thus imparting reciprocating motion to the cutters across the face of the blank. This crank pin D can be adjusted to give various lengths of stroke according to the width of the face of the blank being cut. The vertical shaft C also drives the gearing in the box E, mounted on the top of the sliding head. This gear box is arranged to rotate the blank by means of a series of bevel and worm gears. A clutch F—Fig. 5—is provided which automatically disengages this drive whilst the dividing motion takes place. The shaft giving the rotary motion to the blank actuates also a worm driving a worm wheel keyed to a timing shaft G—Fig. 5—the ratio being such that one revolution of the timing shaft takes place for each cycle of movements. At the front end of the timing shaft G a pitch cam X is mounted directly above the vertical slide. The throw of this cam is either equal to, or a multiple of, the pitch of the gear being cut. Two-thirds of the revolution of the cam is occupied by the downward movement of the saddle slide during which the cutting takes place, and the remaining third lifts the slide to the starting position. A second cam Y on the shaft G de-clutches the drive, which gives the rotary motion to the blank, so that the latter remains stationary during the return movement of the cutter. The timing shaft G is provided with a third cam Z operating a plunger forming a "load and fire" mechanism for starting and stopping the reciprocating movement of the cutters at the correct period.



FIGS. 1 AND 2—DOUBLE HELICAL GEAR GENERATOR—SIDE AND FRONT VIEWS

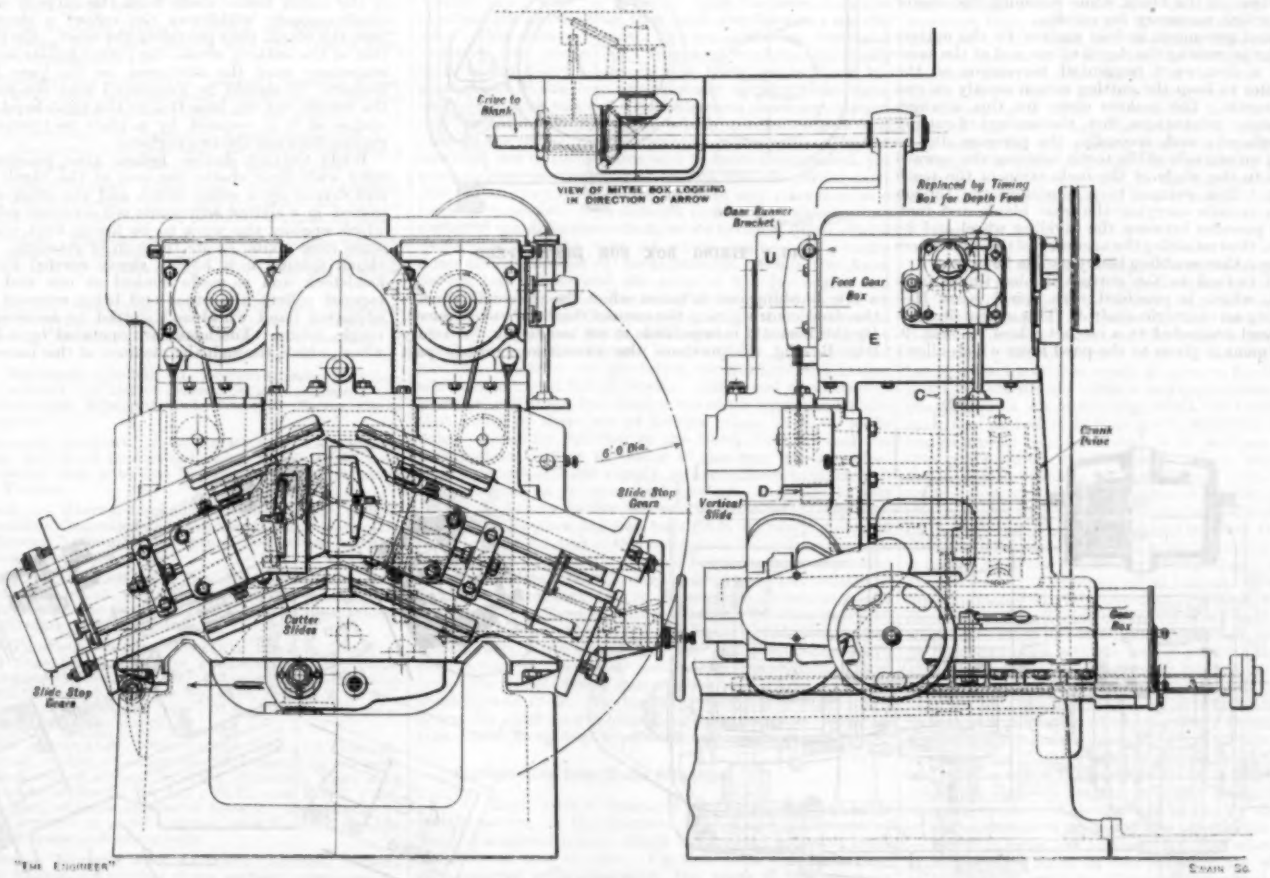


FIG. 3—GENERAL ARRANGEMENT OF GEAR GENERATOR

On the completion of the downward vertical movement of the cutters a continuously rotating striker block carrying two projections is given an endwise movement. These projections strike levers which withdraw the driving plunger connecting the slide carrying the cutters to the connecting-rods previously mentioned. This withdrawal must take place when each cutter has reached its extreme position clear of the blank; therefore the striker block is driven from the worm gear on the crank pin shaft and makes the same number of revolutions. During the return motion of the cutter slide a fourth cam, Z^1, fitted to the timing shaft G, causes a spring to press a belt fork so that a quick running belt is moved from the loose to the fast pulley, thus causing the shaft G to rotate quickly and accelerating the return of the cutter slide. The four cams mentioned now act in a reverse manner, automatically restarting the reciprocating and vertical downward movements of the cutters

FIG. 4—RACK CUTTING TOOL

and the rotation of the blank while resuming the slower feeding movement necessary for cutting.

The patented automatic in-feed motion to the cutters is provided for increasing the depth of cut and at the same time giving a downward tangential movement to the cutters in order to keep the cutting action mostly on one side of the tooth. The makers claim for this arrangement two distinct advantages, first, the amount of cutting surface is reduced; and, secondly, the pressure due to the cut being on one side of the tooth balances the upward pressure due to the angle of the inclination of the teeth viz., 22½ deg. This reduces to a minimum the torsion on the main spindle carrying the gear blank, and incidentally the pressure between the dividing wheel and its mating worm, thus retaining the accuracy of these members and at the same time enabling heavy cuts to be taken.

The direct in-feed to the cutters is also timed from the shaft G, which is provided with spiral gears H—Fig. 5—driving an excentric shaft J. This excentric shaft actuates a pawl connected to a ratchet wheel K—Fig. 9. Screw adjustment is given to the pawl lever which allows and allows another pawl, which is continuously actuated during each cutting operation, to engage with a ratchet wheel N, giving motion through change gears to the worm gears P driving excentrics W—Fig. 8—which in turn move the sliding head towards the centre of the

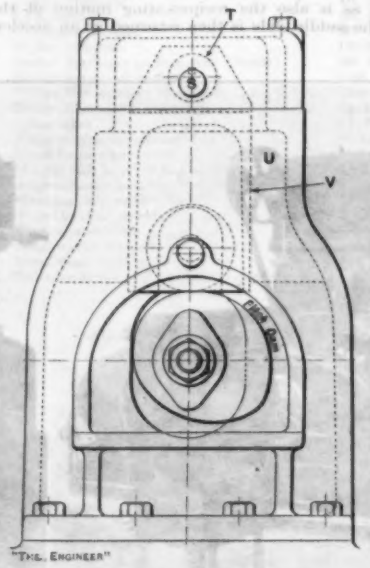


FIG. 7—PITCH CAM BRACKET

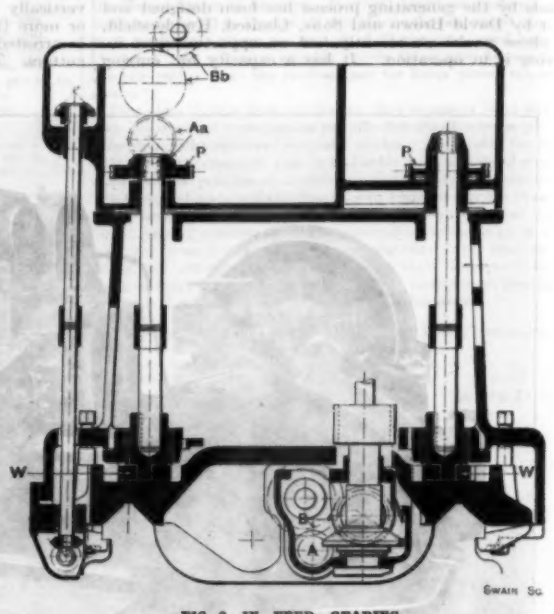


FIG. 8—IN-FEED GEARING

gear, thereby increasing the depth of cut. These excentrics give a gradually decreasing amount to the added depth of cut, which enables approximately the same volume of metal to be removed with each cut. Finally,

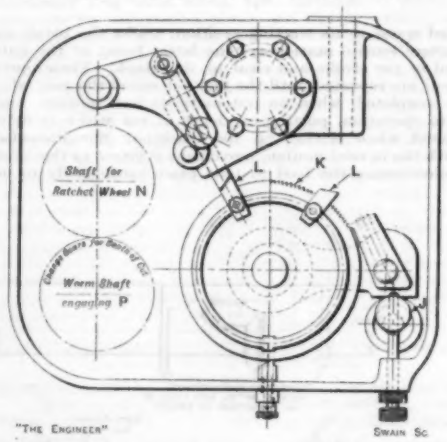


FIG. 9—TIMING BOX FOR DEPTH FEED

a fine finishing cut is taken when the excentric reaches the dead centre giving the correct depth of cut required. By this means it is impossible to cut too deeply. A safety trip R—Fig. 5—prevents the excentric running past

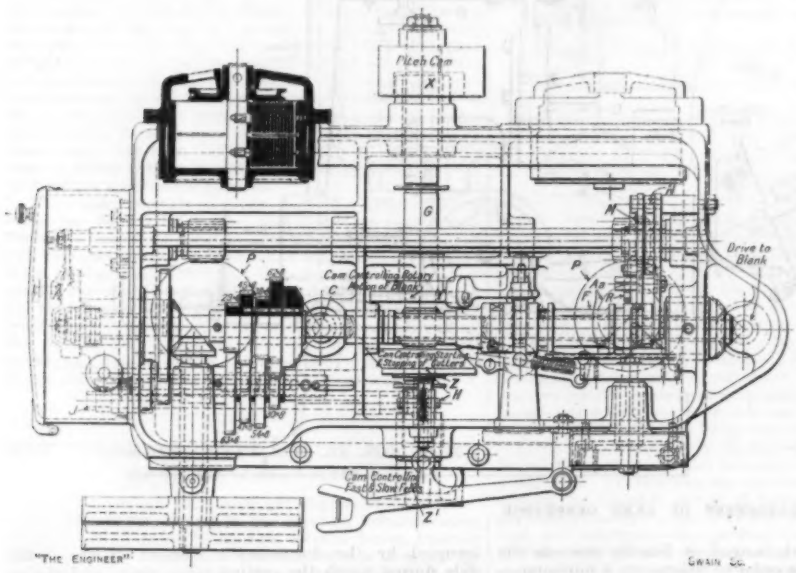


FIG. 5—FEED GEAR BOX

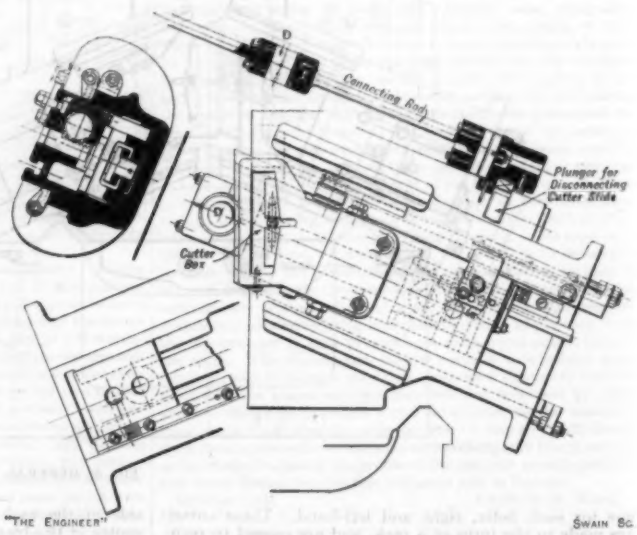


FIG. 6—ARRANGEMENT OF SLIDES

for variation of feed from 1 to 4 teeth. This ratchet wheel K is fitted with adjustable dogs L set to coincide with the number of teeth being cut. The number of dogs used equals the number of times the blank will rotate to reach the full depth of cut. These dogs act upon a lever which removes an obstructing piece M—Fig. 5—the dead centre. To obtain the downward tangential movement to the in-feed one of the worm wheels P actuates bevel gears A *a*—Figs. 5 and 8—which drive by means of change wheels B *b*—Figs. 5 and 8—and universal joints, a telescopic shaft S situated above the gear box. This shaft is connected to an excentric T—Fig. 7—carried in a bracket U attached to the vertical slide. The excentric engages a sliding block V carrying a cam runner. This cam runner is in contact with the pitch cam. The rotation of the excentric allows the slide through the bracket U to make a slight downward movement in proportion to the inward movement, thus giving a tangential movement to the cutter at the same time as the depth of cut is being increased.

In order to give a slight amount of relief to the cutters during their return stroke each of the cutter holders is free to slide upon its base to a slight extent. During the cutting stroke a friction driving device E *e*—see Fig. 2—keeps the cutter holder C *c* pressed against an abutment on the base D *d*, as shown by the upper arrow on the left-hand cutter holder—Fig. 2. At the beginning of the return stroke the friction device E *e* holds the cutter holder, while the base moves a short distance alone, as indicated by the lower arrow on the right-hand side until the lock nuts F *f* strike the projection G *g*. The slideways between the tool holders and the base are not parallel to the front face of the holders, but are inclined in such a manner that the relative movement of the cutter holder away from the support on the base simultaneously withdraws the cutter a short distance from the blank, thus providing the relief. On the resumption of the cutting stroke the cutter holder is again held stationary until the abutment on the base D *d* makes contact. It should be mentioned that the gap between the holder and the base D *d* on the right-hand side is not visible as it is covered by a plate to prevent cuttings getting between the two surfaces.

When cutting double helical gear pinions mounted solid with their shafts one end of the blank is gripped and driven by a collet chuck and the other end is supported in a sliding adjustable self-centring roller steady, which enables the work to be firmly held, whilst at the same time giving entire freedom of rotation. The collet chuck spindle is a hollow sleeve carried by the work headstock and is made conical at one end to receive tapered collets, the other end being screwed to suit an adjusting hand wheel and slotted to accommodate two toggle levers. The latter are operated by a large hand wheel, which, through the medium of this increased leverage, provides for a great increase of pressure on the worm shaft. The roller steady is provided with a top and bottom pair of rollers, these being simultaneously operated by means of two movable jaws controlled by a horizontal hand wheel and adapted to accommodate shafts of different diameters.

When the cutters and blanks are correctly mounted, the cutter head is fed towards the latter with the excentrics W on their inner dead centre, until the cutters just slightly touch the outer diameter of the blank. The excentric is then adjusted to bring the cutter clear of the blank, and the micrometer dial on the cutter head hand wheel shaft is set forward the full depth to be cut. the excentrics W are then rotated whilst the machine is running until the depth of the first cut is reached, after which the blank makes one complete revolution. The full depth of cut is then automatically reached by means of the mechanism already described. Rim stays are provided on either side of the blank to take the cutter thrust.

The machine is very substantially constructed and produces true involute teeth cut right to the apex at the centre of the face of the wheel.

Catalogues.

THE DUNLOP RUBBER COMPANY, Limited, Birmingham.—A leaflet dealing with the Dunlop balloon tires.

E. L. PRICE, Limited, 6, Upper Bedford-place, W.C. 1.—A catalogue dealing with aerial ropeways and transporters.

WORTHINGTON-SIMPSON, Limited, Queen's House, Kingsway, W.C. 2.—A catalogue of "Condensing Apparatus."

THOMAS SMITH AND SONS (Rodley), Limited, Rodley, Leeds.—A catalogue dealing with locomotive breakdown cranes.

F. AND A. PARKINSON, Limited, Guiseley, Leeds.—A catalogue illustrating and describing the Parkinson A.C. motor.

AUTOMATIC AND ELECTRIC FURNACES, Limited, 173-175, Farringdon-road, E.C. 1.—"Heat Treatment Bulletin," No. 33.

THE VISCO ENGINEERING COMPANY, Limited, 82, Victoria-street, S.W. 1.—Catalogue No. 24 dealing with the Visco air filter.

R. B. TENNENT, Limited, Whifflet Foundry, Coatbridge.—A book illustrating and describing the Whifflet Foundry and its work.

THE NATIONAL BOILER AND GENERAL INSURANCE COMPANY, Limited, Manchester.—A copy of "Heating Boilers." Price 1s. 6d.

RICHARDSONS, WESTGARTH AND CO., Limited, Hartlepool.—Copy of a booklet by Mr. D. B. Morison on "Propelling a Cargo Boat."

AERSEDCON, Limited, 17, Store-street, W.C. 1.—A booklet illustrating and describing the "Aersedcon" system of sewage purification.

COX AND DANKS, Limited, 168, Regent-street, W. 1.—Latest stock list containing representative items of iron and steel in the firm's warehouses.

MAVOR AND COULSON, Limited, 47, Broad-street, Mile End, Glasgow.—Monthly Journal No. 38, Vol. IV., on "Mechanical Aids for the Mining of Coal."

THE BIRMINGHAM SMALL ARMS COMPANY, Limited, Birmingham.—A booklet briefly describing some of the special machines supplied to engineering firms.

JOHN DAVIS AND SON (Derby), Limited, All Saint's Works, Derby.—A leaflet No. 4242A, dealing with the "Davis Scurfield" split unit scale slide rule.

SUPER-CENTRIFUGAL ENGINEERS, Limited, Imperial House, Kingsway, W.C. 2.—A catalogue describing the many processes to which the Sharples super-centrifuge has been applied.

THE NORTON COMPANY, Worcester, Massachusetts, U.S.A.—A booklet illustrating and describing the Norton floor, also a booklet illustrating and describing Norton porous plates.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Limited, Trafford Park, Manchester.—A descriptive leaflet No. 591/1-1 describing the use of the magnetic brake for tramcar service.

J. T. PICKLES, Mytholm House, Hebden Bridge.—Leaflets on J.T.P. veneer and plywood machinery, J.T.P. woodworking machinery, and J.T.P. woodworking cutter heads and machine knives.

THE MITCHELL CONVEYOR AND TRANSPORTER COMPANY, Limited, 45-50, Holborn-viaduct, E.C. 1.—Catalogue illustrating and describing mechanical appliances for the handling of material.

SULZER BROTHERS, Limited, 31, Bedford-square, W.C. 1.—A booklet entitled "A List of Motorships in Commission and under Construction Equipped with Two-cycle Sulzer Diesel Marine Engines."

THE MACLEAN COMPANY OF GREAT BRITAIN, Limited, 88, Fleet-street, E.C. 4.—A booklet containing details of the publications owned and published by the Maclean Publishing Company, Toronto.

RANSOMES AND RAPIER, Limited, 32, Victoria-street, S.W. 1.—Three booklets illustrating and describing electric-locomotive hoists, "Bowtell" patent luffing cranes, and refuse handling electric transporter cranes.

ALFRED J. AMSLER AND CO., Schaffhouse, Switzerland.—Abridged catalogue E25, containing a short historical sketch and curtailed illustrative accounts of the Amsler testing machines and precision measuring instruments.

BRITISH THOMSON-HOUSTON COMPANY, Limited, Rugby.—Illustrated price list No. 5270 of hand-operated three-phase auto-transformer starters, type AHT, for squirrel-cage induction motors, and illustrated price list No. 5610, Section 2, of A.C. contactor control equipments, type T.M.C., for reversing polyphase slip-ring induction motors.

THE NEW SWITCHGEAR CONSTRUCTION COMPANY, Limited, Wellesley-road, Sutton.—Leaflets No. 2311 describing the iron-clad oil-break switch pillar; No. 2401, describing sheet steel cubicles and switchboards for L.T., H.T., and E.H.T.; No. 2402, describing oil-immersed switch fuses for pressures up to 3300 V. and currents up to 500 ampères; and No. 2403, describing S.P. hook-operated isolating links.

THE BUTLER MACHINE TOOL COMPANY, Limited, Victoria Ironworks, Halifax.—A number of new sectional catalogues:—Sheet No. 2a, on 20in. to 22in. and 24in. to 26in. crank shapers; Sheet No. 2b, on 8½in. toolroom shaper; Sheet No. 3-3a, on high production slotters and patent tilting body slotters; Sheet No. 3b, on high production slotters, 12in. to 14in., 18in. to 20in., and 24in. to 26in.; and Sheet No. 4, on puncher slotters.

HENRY WIGGIN AND CO., Limited, 55, George-street, Birmingham.—A series of booklets as follows:—Booklet No. 1, "The Alloys of Nickel, Copper and Zinc (Nickel Silver)"; booklet No. 2, "The Alloys of Copper and Nickel"; booklet No. 3, "The Alloys of Nickel and Chromium"; booklet No. 4, "The Electro-deposition of Nickel"; booklet No. 5, "Malleable Nickel"; booklet No. 6, "Corronil"; booklet No. 7, "High-grade Electrical Resistance in Wires and Tapes," and "Cobalt."

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

An Unstable Market.

CONDITIONS in the Midland iron trade are very unsettled, and at the weekly meeting in Birmingham to-day—Thursday—the tone was moody and depressed. Conversation was divided between business and politics. The prospects of a trade revival between now and Christmas have not been improved by the dissolution.

Irregular Raw Iron Values.

With coke cheaper, stocks threatening, and competition for business very keen, pig iron prices are being forced down in the Midlands. Last week and again this week consumers have been successful in obtaining concessions, and there is no indication that the fall in values has yet reached bottom. While readjustments are in process there is naturally very little buying, with considerable irregularity in quotations. In some cases there has been a pretty drastic marking down of prices, the depreciation amounting to as much as 5s. per ton. Northamptonshire smelters betrayed a good deal of anxiety to relieve stocks, and for the time being their prices are disproportionately low as compared with those quoted by Derbyshire houses. While there was a drop of 2s. 6d. to 3s. 6d. in Northamptonshire forge, the descent was not quite so steep as regards foundry qualities. Derbyshire forge was quoted at 5s. to 6s. above Northamptonshire. Though £3 15s. is substantially lower than the rates which were tentatively mentioned last week, it must be regarded as a nominal figure. Those smelters who attempted to arrest the downward tendency by quoting last week's minimum found their efforts unavailing. Derbyshire No. 3 at £4 2s. 6d. was the makers' protest. They hardly expected to attract business at that figure, and having registered their protest, would have been content in many cases to negotiate on a lower basis. The very low prices quoted by some producers encouraged a few sales. Although makers of pig iron declare that business is quite unprofitable they still compete keenly for any available orders. Stocks at some furnaces are stated to be rather heavy. Staffordshire cold blast iron has been reduced 10s. per ton, making the basis £10 10s. This high-class material is used largely for heavy castings, and the foundries producing rolls and mill machinery have cut their prices for chilled rolls £1 per ton, grain rolls remaining unchanged.

Structural Steel Prices.

There is very little business being transacted in the steel market, especially as regards heavy material. The slight improvement in the demand for structural material, however, has been maintained, an acceptable feature being that for some of these the steel tonnages involved are heavier than they have been for many months past. This class of business has brought some acceptable orders to the steel mills. Increased business, especially in rails and heavy plates, is now badly needed, and the steel works in this area are generally working short time. Orders continue to be of a miscellaneous character, involving frequent roll changing, which checks output and reduces the profit-earning capacity of the mills. Profits, however, are in many cases said to have disappeared, yet price cutting continues, and though the old official rates still stand, they have ceased to have any relevance as a basis of business. It is difficult to arrive at exact prices owing to the difference which exists between quasi-official quotations and the rates at which business is actually done under pressure of circumstances. While the Association has not revised the price of £10 for angles and joists, free competition has brought the market level down pronouncedly. On 'Change to-day angles and joists could be freely bought at £9 5s. and tees at £10 5s. Common small steel bars also changed hands at £9 5s. No alteration has been made in the quotation for Staffordshire hoops, which remains at £12 at works. Additional quantities of joists are called for, but there is too much reason to believe that many of these are of foreign origin, Belgian joists being offered for delivery in the Black Country and the Birmingham district at under £7 per ton, the manufacturers undertaking to supply in accordance with British specifications as to sizes and quality. Belgium is also competing keenly for the overseas business and is effective, being able to place finished bars f.o.b. Antwerp under £6 per ton. A good deal of this business is being done through Birmingham merchants. Scarcely any business is passing in native billets. British steel makers generally adhere to the £7 10s. standard, and in a few cases are asking a still higher figure. Even at this price it is said they carry no profit. On the other hand, it is reported that prices considerably lower than the £7 10s. generally quoted have been accepted. A lot of continental semi-finished steel is on offer, billets being quoted at as low as £6 2s. 6d. and sheet bars at £6 5s. The building trade has brought a few orders for steel bars required for ferro-concrete construction. Steel scrap continues weak and nearly unsaleable.

Staffordshire Iron Trade Situation.

Last week's quarterly meeting afforded little enlightenment on the question of the new alignment of finished material prices, which is expected to result from the reduced cost of coke. Pig iron alone has undergone any material price alteration, but users of the products made from pig iron expect that readjustments will not stop at the raw material. The fall in pig iron since the July quarterly meeting has been much more pronounced than the fall in some of the finished material into which pig iron enters. The Staffordshire finished iron trade continues gloomy, with the exception of marked bars, which are retained at £15 per ton, the price to which they were advanced in April last. Makers report fairly satisfactory order books. Rollers of medium iron of Crown quality find it difficult to get business, and although the standard remains £13, business is claimed to have been done at 5s. to 7s. 6d. below that figure. In spite of continental competition, the common bar mills, or the majority of them, hold on to their quotation of £12 for nut and bolt and fencing iron. The steel re-rolling mills are not quite so busy as they were, but have a fair amount of employment, mainly, however, utilising foreign semi-finished material. Iron strip is being cut below the price ruling, but orders are still being taken at £13 5s.

Galvanised Sheets.

The galvanised sheet trade is showing a little more animation, inquiries having been much more numerous during the past week with a fair proportion of new business. Values, however, have not materially altered, prices ranging between £18 and £18 5s. for galvanised corrugateds of 24 gauge. The motor trade is taking good quantities of black sheets of the thinner gauges.

Tinned and Lead-coated Sheets.

Tinned sheet prices have been re-declared as follows:—Best charcoal, £58 per ton; charcoal, £56; unassorted grades, £52 per ton to 20 gauge. Lead-coated sheets have also been reaffirmed at £28 per ton to 20 gauge. Makers of tinned plate are fairly busy on foreign orders, and are buying an increasing proportion of semi-finished steel from abroad. The high price of tin is largely accountable for the maintenance of the £1 3s. 6d. per box figure for tin-plates. There is a slow district trade in wasters at 1s. less.

Unemployment.

The unemployment returns for the Midlands continue fairly satisfactory, the figures showing the total out of work for the week ended October 6th to be 149,027, as against 149,185 the previous week. The latest total is made up of 105,601 men, 2891 boys, 36,827 women and 3708 girls. Of these, the Birmingham area is responsible for 38,060; Coventry, 3739; Bilston, 3056; Cradley Heath, 4746; Dudley, 4253; Oldbury, 2027; Smethwick, 5073; Stourbridge and Brierley Hill, 4017; Tipton, 2352; Walsall, 5531; West Bromwich, 3870; Wolverhampton, 6659; and Worcester, 1663.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Conditions.

THE markets are all more or less disturbed this week by the agitation connected with the General Election, although as we have had several General Elections lately the disturbance is less than it used to be when these events came only once in six years. Eventually, if things go on after the recent fashion business men will become so accustomed to political trouble and confusion that they may not take much notice of it. One may probably assume, however, that any chance of an autumn revival is now knocked on the head, and the most that can be expected by the optimists is that buying of iron and steel may improve a little before the end of the year. Rather more likely the revival of the iron trade must now be relegated to the spring of 1925. Consumers here are evidently of opinion that there is no need to be in any hurry to give out orders, for the waiting policy has paid very well all through the year, and may very probably pay up to the early spring. At any rate, in the Lancashire district one cannot find any disposition to buy material.

Metals.

The market for copper is dull and quiet, and consumers do not show any apprehension as to the chance of higher prices in the near future. As your readers know, the usual publication of statistics has been suspended in America for some time, and the belief is growing that the statistical position there is steadily getting worse. That belief is the inevitable result of secrecy, for things that are unknown are always subject to exaggeration. People say that there is an increasing stock of unsold copper in America, and that this is quite sufficient to check the beginnings of any advance. It is perhaps not probable that copper prices will fall to any extent below the present level; but consumers are averse from holding more stock than is needed unless there is some definite chance that a rise in prices will come before the loss of interest involved in the holding of copper amounts to more than any probable advance. Until one has some clear idea on this point it is rash to advise consumers to buy simply because prices are moderate. The scrap metal market, which very often first indicates an improvement, remains very dull and depressed, and with the exception of old lead, scrap dealers seem inclined to avoid buying old metals, and when they do buy they offer only the lowest prices. Hence it is that scrap gun-metal is sold at many pounds per ton below its intrinsic value. The market for tin has remained in a very variable mood, and even experts here are quite unable to give any indication of what is likely to happen. On the one hand there is the approaching exhaustion of the reserve stocks in the East, which, of course, is a "bull" point; and on the other there seems to be a diminution of the American demand for the tin-plate trade there. If the tin-plate trade in America fails to justify the expectation of the market then no doubt the price of tin is quite high enough. It must not be forgotten that aluminium is now being used for some of the purposes for which tin was formerly indispensable. The market for lead has kept very strong, and there is still a tendency towards higher prices. This time the movement seems to be supported by something more than the speculative spirit. Germany seems to be in need of more lead, and the consumption of the metal in the accumulator industry is growing. Spelter, on the other hand, is a quiet market and is mainly sustained by sympathy.

Pig Iron.

The market for foundry iron in Manchester is decidedly weak again, although some sellers are still hold-

ing out for the old prices. It is, however, now only one or two brands of Derbyshire iron which cannot be bought at 90s. per ton delivered here, and it is said that on the other hand there are offers at rather less than this limit. A month ago ironfounders here were ready to buy fair quantities for delivery over the remainder of the year at 90s. delivered; but this willingness is no longer apparent, and most consumers here are holding back to see whether prices are likely to recede much further. The extreme weakness of Northamptonshire iron, which may easily spread to Lincolnshire, induces the belief that Derbyshire No. 3 may yet have to fall, although the makers assert that any further reduction is out of the question. Northamptonshire makers seem to have given away already the full benefit of the reduction in furnace coke; but Derbyshire sellers have not yet consented to part with half of it. It is easy therefore to understand that the market here is in a very confused condition, and that actual business is restricted. Scotch and hematite irons are again weak, and for the latter (*i.e.*, for East Coast brands) down to 100s. delivered here is mentioned. Scotch iron cannot be bought within 4s. of that price, and consumers here think that it is ridiculous to have to pay more for Scotch foundry than for hematite. One reason, however, is, of course, the excessive carriage on Scotch iron.

Finished Material.

The markets here for manufactured iron and steel seem to be more adversely affected by the political situation than the pig iron market. Perhaps this is because it is conceivable that certain political changes might bring about some control of the import trade in finished iron and steel, whereas it is scarcely conceivable that any measures affecting pig iron would be taken. There was very little inquiry for steel and iron before the dissolution of Parliament, and there is rather less now. The nominal prices show no change, but then it is generally understood that these are about as low as they can be in existing circumstances. In Manchester merchants still quote £9 7s. 6d. per ton for joists and angles, £10 2s. 6d. for plates, £10 for flat bars, and £10 5s. to £10 10s. for round bars.

Scrap.

The market for all kinds of scrap remains very dull and quiet, but it is now expected that the Sheffield consumers will soon come into the market again, although probably the prices offered for steel scrap will be low. As the South Wales works will not pay over 80s. per ton for heavy melting steel scrap, it is probable that the Sheffield users will expect to buy at 70s. delivered. Any scrap bought in Lancashire at 60s. will leave a small profit, but a fair proportion of the stock held by dealers has cost more than this. Heavy wrought scrap is in only very small request, dealers still trying for 85s. delivered and the ironworks offering 80s. Cast scrap is depressed in sympathy with the pig iron market. The values here range from 80s. to 85s. per ton, according to quality.

BARROW-IN-FURNESS.

A Dull Market.

The trade in hematite pig iron continues to be dull and there is really no new development to report. Home customers are confining their orders to small lots, and there is still no prospect of a general recovery. The fact that the Barrow steel works are still closed down as far as the rail and other important branches are concerned means that the iron works production has to go into stock or find a market. As trade is so dull the stocks will increase, although orders have been received for America, but to what extent is not known. The trade with the Continent is poor. A cargo was despatched to Ghent and Antwerp last week. There has not yet been a reduction in the number of furnaces in blast, but such a happening would not be surprising. The business being done in special qualities of iron is small. The charcoal furnace at Backbarrow is still employed and is enjoying a certain amount of trade in iron needed for special purposes.

Iron Ore.

The iron ore trade continues to be quiet and none of the mines in the district can be called busy. This state of affairs will be changed for the better or the worse as the pig iron trade moves. There is not more than a small trade outside the district. Foreign ore is in moderate demand and cargoes are coming in from Spain, &c., in limited tonnage.

Steel Trade.

The steel trade is very quiet. The Workington rail mills are at work again, but it is not expected that they will have a long run, as orders are by no means plentiful. The Barrow rail mills are still idle and there is no sign of them re-starting again at the present. The hoop and small section mills are better circumstanced and have orders to keep them going. Foundries are only moderately employed.

Shipping.

The Barrow docks have never had so many cross-Channel steamers laying up in them as at present. Apart from the Isle of Man Steam Packet vessels which are now at their winter quarters at Barrow, practically the whole of the L.M.S. cross-Channel steamers, including the Anglia, one of the fastest vessels of her class in this country, are at Barrow. The Duke of Clarence, which runs in the season between Hull and Zeebrugge, is also in dock, having just completed her season. This will mean a certain amount of work for the town when they are overhauled. There is some talk of some of the L.M.S. vessels having oil fuel plant installed.

SHEFFIELD.

(From our own Correspondent.)

Settlement of the Steel Strike.

A SATISFACTORY item of news this week relating to the heavy steel trade of the district is that the strike, which has paralysed three of the largest works for seven weeks, is settled. Terms were offered by the firms which the men accepted by ballot, and they have resumed work, leaving some matters still to be settled by negotiation. The resumption was on a good scale, especially at Steel, Peech and Tozer's, where twelve furnaces were got to work on Monday, and it was anticipated that by Wednesday practically all the workers would be taken back. Messrs. Samuel Fox and Co. were only able to take 30 per cent. of their men back on Monday, but they also expected that all would be at work by Wednesday. The Parkgate Iron and Steel Company could only set a comparatively small number of men on on Monday, but at this works also things improved during the week, and it is fully expected that full employment will be found by next Monday. This does not mean, of course, that the heavy trade is particularly busy; in fact, its condition shows no improvement. There is no sign of that revival in buying which is needed to bring prosperity to the industry. Mr. C. P. Markham, who is chairman of the Parkgate Iron and Steel Company, as well as of the Staveley Coal and Iron Company, in a speech on Saturday, stated that the steel trade was in an absolutely hopeless condition. Steel works were gradually shutting up, and they looked like remaining closed. Until they got at least 6s. per ton off the price of coal, he saw no possibility of steel works as a whole reopening.

Reduced Production of Steel.

The poor state of the trade locally is shown by the figures of production for August. The output of steel ingots and castings in the Sheffield district for that month was 63,400 tons, as compared with 81,500 tons in July, and 94,700 tons in August of 1923. Of the total, 27,800 tons were acid, 25,600 tons basic, and 4400 tons Bessemer. Production of steel in Lincolnshire in August amounted to 24,000 tons, or 8000 tons less than in July and 16,000 tons less than in August last year. The output of pig iron in Lincolnshire in August was practically the same as in July.

The United Steel Report.

The annual report of the United Steel Companies, which has appeared during the week, is of much interest, in view of the widespread nature of this great combine. As your readers will recollect, United Steels are the owners of the firms of Steel, Peech and Tozer, Samuel Fox and Co., the Frodingham Iron and Steel Company, the Workington Iron and Steel Company, the Rother Vale Collieries, and a number of other businesses. The directors consider that, having regard to the general conditions prevailing, the results of the working for the year ended June 30th last were not unsatisfactory. The trading of the branches and subsidiary companies resulted in a net profit, before providing for depreciation, income tax, and corporation profits tax, of £670,083, compared with £605,506 for the previous year. After deducting income tax, debenture and obligation interest, and reserves for sinking fund and taxation, the accounts show a net surplus of £903,081, as compared with £666,149 brought in. The directors point out that since the close of the financial year the conditions affecting the steel trade of the country generally have been more unsatisfactory, foreign competition in particular having increased considerably. They also refer to the strike which brought two of the works to a standstill. In view of these conditions, they do not recommend the payment of any dividends. Some surprise has been expressed by shareholders at this recommendation, as it had been thought that the company would be able to resume the payment of preference dividends this year. Those dividends are two and a half years in arrear, but it would only take £197,625 to clear them off. It is also pointed out that a dividend of 5 per cent. on the ordinary shares could have been paid with £400,325, and that, after both these items had been deducted, the surplus would still amount to £305,131. No doubt something will be heard about the matter at the annual meeting of the company on Monday next.

A Good Buffer Order.

Conditions on the manufactured side of the steel trade are much better than those in the crude steel departments. They are not uniformly good, but some firms are well placed for work. Orders for railway supplies continue to provide a good deal of employment, and one firm engaged in this trade which is very busy is that of George Turton, Platts and Co., Limited. Only a week or two ago Messrs. Turton, Platts received an order for 6500 complete buffers of the large Indian type for the East Indian Railways, and this has been followed by an order for 4500 buffers from the India Office. The volume of buffer orders on the books of the firm's Meadow Hall Works is now larger than at any previous time. The works are busy night and day, and these orders assure them of similar activity throughtout the winter. The Furnival-road stamping department is also working night and day.

Various Departments.

In other respects, the conditions in the steel trades of the city and district are very variable. The setback experienced by the crucible branch a few weeks ago is still in evidence. The demand for files and engineers' small tools has eased lately, and is not nearly so good as it was in July. There is much activity in the cold-rolling of steel, and also at the wire rope works, which send good quantities of their products regularly to a number of oversea countries. In wire and wire rods, things have quietened down somewhat, but a good deal of work is still being done. Very good reports come from the tube works of Chesterfield and the big Derbyshire cast iron pipe works. On the other hand, there is a great shortage of work on the heavy engineering side, and the few local ironfounders working for the engineering trade are also quiet. Full time is being worked, however, by the makers of light castings for builders, and all classes of material and tools for the building trade are in capital demand.

Cutlery and Plate.

A considerable improvement in activity is reported in these branches, consequent upon buying for the Christmas trade. Stainless knives, spoons and forks and plated goods in cases are being sent out on an increasing scale, and the quantities are very large. The bulk of the demand is for articles on the cheap side, but there is also a steady, if limited, inquiry for good class silver and plated services. That section of the industry which produces articles of medium quality is the quietest. There is a fair demand for the best grades of penknives, and a few firms are busy on their production. An increasing request for penknives with stainless blades is noted. Some good orders are reported. One of these is for 220 dozen table knives with ivory and plated handles, and has been placed by the White Star Line in Sheffield and Birmingham. Big distributing houses in London have given out a valuable contract for silver and electro-plate, and very large orders for stainless cutlery. A cheering feature in connection with these trades is the improved buying of foreign markets. Nearly half of the export business is still done with Australia and Canada, but countries outside the Empire are taking larger quantities of both cutlery and plate than they have done for a considerable time. A forthcoming fusion of two well-known firms in these trades is reported. The proposal is that Gladwin, Limited, a prosperous young company which secured the cutlery contract for Lyons' restaurants at Wembley, should acquire by an exchange of shares a controlling interest in Martin, Hall and Co., Limited, a firm which has been in business about 100 years.

Economy in Highway Work.

I have on more than one occasion referred to the modern methods of road construction now largely in operation in Sheffield, and a tribute to their efficiency and economy appears in the annual report of the Highway and Sewerage Committee of the City Council, just issued. The document states that since 1914 the length of roadways repairable has increased by 54 miles, but the total expenditure is now little above the pre-war level. The average cost per mile for the year 1923–4 was less than before the war, being £216 as against an average of £254 for the seven pre-war years. This is a somewhat remarkable result, and two factors which have contributed to it are the extensive use of tar macadam in place of water-bound macadam before the war, and the substitution of clinker asphaltic surfaces for paving since the war. The report goes on to state that Sheffield has been practically free from complaints about slipperiness, a result which may be due to the fact that all roads painted with tar and bitumen are immediately covered with fine chips, carefully rolled in, which give some grip to tires as well as horses' feet. Very careful attention has been given to the subsequent sanding of places where otherwise danger might arise.

A Railway Development.

New plant which will make for efficiency and economy is to be installed at the London and North-Eastern Railway works at Doncaster. The directors of the company have authorised the provision of an electrically operated automatic mechanical coaling and sanding plant for their locomotives at that centre, at a cost of £30,000. The plant will enable the coaling and sanding of engines to be performed much more rapidly at a considerably reduced cost, and it will increase the time during which the locomotives will be available for traffic purposes. Coal and sand will be supplied simultaneously.

Tramway Rails.

The tramway rails required by the Hull Corporation, about which so much was heard a few weeks ago, are to be made in this country after all. The first decision, to give the contract to a German firm, has been rescinded, and it was resolved to place the order at Middlesbrough, at a cost of £3000 more. The voting in the Council was very close, the Middlesbrough resolution being carried only by 26 votes to 25.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

SOME expansion in business has been noticeable in the Cleveland pig iron trade this week, despite the disturbing influence of the General Election. Producers are still adhering to their policy of stabilisation of prices. The steady downward trend of prices during recent months has been one of the greatest obstacles to business. It has not merely discouraged business, but has offered a definite inducement to consumers to delay purchases to the last possible moment. Now it is felt that if stability can be achieved orders will be released, and in that hope makers are resisting any further drop in prices. The weakness of the Midland markets is an adverse influence, but traders with their fingers on the pulse of industry take a rather more hopeful view, although there has not as yet been any real business expansion. However, it is significant that a few sales of Cleveland iron are reported for delivery up to the end of the year, and in the early months of 1925. That is a new development. Hitherto there has been no forward buying, and the change in the attitude of buyers in this respect carries with it the inference that they are satisfied that prices are approaching, if they have not actually touched, rock bottom. Scotland has been buying a certain amount of Cleveland iron, and there are also a few export inquiries, but the foreign trade is still very restricted. No. 1 Cleveland foundry iron is quoted at 85s., No. 3 at 80s., No. 4 foundry at 79s., and No. 4 forge at 78s. per ton.

Hematite Pig Iron.

There are no new features of moment in the East Coast hematite pig iron trade. The demand is still so restricted that even the stoppage of three furnaces has failed to arrest the fall in prices, and mixed numbers have been sold at 87s. per ton, which is now the recognised market price.

Ironmaking Materials.

The foreign ore trade is lifeless, and best Rubio ore is nominal at 21s. 6d. per ton c.i.f. Tees. Good Durham furnace coke still commands 25s. per ton delivered at the works, and although there is little local demand, there is a steady export inquiry.

Manufactured Iron and Steel.

A reduction in the prices of certain manufactured steel products is the feature of the manufactured iron and steel trade this week. There has been no change in the price of steel plates, angles and joists since the beginning of the year, the system of agreed prices having enabled a remarkable degree of stability to be established. But there has been in the interval since the last revision of prices a very substantial drop in the costs of production, particularly in regard to the price of pig iron and scrap, and it has created no surprise, therefore, that at length the makers have agreed to a reduction of 10s. per ton in the home price of steel boiler plates, steel ship, bridge and tank plates, steel joists and angles. It is hoped that this reduction, which has been anticipated for some time past, will stimulate trade by securing the release of orders held back for lower prices; but it is too soon yet to indicate whether that hope will be realised. The revised quotations are :—Steel ship, bridge and tank plates, £9 15s.; steel boiler plates, £13; steel angles, £9 10s.; steel joists, £9 10s.

The Coal Trade.

The depression in the Northern coal trade is still very acute. The situation, so far as Northumberland is concerned, appears to be ge ting worse, and the outlook is exceedingly gloomy at the moment. The demand for Northumberland steam coal has fallen away to a quite remarkable degree, and whilst collieries have been quoting nominal values this class of coal has been offered by second hands as low as 17s. 3d., which is about 9d. per ton less than the figure indicated a week ago. In the Durham section, second-class gas coal and coking coal have been a little better in demand, and patent coke is also meeting with a stronger inquiry, but business matures very slowly. While a little better feeling has been induced by the increased inquiries, the fact cannot be overlooked that the present position of the coal industry in Durham is still very discouraging. At this time of the year it is usual for large contracts to be placed by industrial firms, but these have not matured so far this month, for there is very little purchasing ahead. Unemployment is still a serious matter, for forty-eight pits are closed in Durham and eleven in Northumberland, whilst others in each county are only partially employed. During September the quantity of coal shipped from the Tyne was 1,360,831 tons, as compared with 1,634,713 tons in the corresponding month of last year, a decrease of 273,882 tons. The coke shipped last month was 95,920 tons, or a decrease of 47,200 tons on September of last year. The coal and coke shipments for the nine months of the current year totalled 14,512,693 tons, as against 15,860,559 tons for the corresponding period last year. Bookings for coke shipments during the next week or two are fairly satisfactory, and although stocks are considerable, prices are fully steady.

Cleveland Miners' Wages.

The question of wages during the current quarter was under consideration at a joint conference this week of the Cleveland Ironstone Minowners' and the men's representatives. Under the ordinary operation of the sliding scale arrangement, based upon the selling price of Cleveland pig iron, the employers were entitled to reduce wages by 5.2 per cent. A strong appeal was made by the men's representatives on behalf of the datal and lower-paid workers in the mines, and the owners showed their sympathy by foregoing their claim. No reduction, therefore, will be made, wages remaining at 78 per cent. above the standard.

Big Steel Order from Germany.

An order from Germany for 15,000 tons of steel plates has been secured by Dorman, Long and Co., Limited, and it will be executed at their Redcar Works. This week the rolling mills have gone on short time through a lack of orders, the work in hand—an order for 1000 tons of steel plates—being sufficient to keep them working to the end of the week. This new order, however, will mean a renewal of activity at the works for a few weeks ahead.

SCOTLAND.

(From our own Correspondent.)

Conditions Unchanged.

Generally speaking, the industrial situation is unchanged, and markets have remained in a comparatively inactive state throughout the past week. The political situation now absorbs all interest, providing almost the sole topic on 'Change, and until the General Election is over little attention will be devoted to other matters.

Pig Iron Still Declining.

The lack of business in Scotch pig iron becomes more and more apparent as time passes. The home demand is confined to small immediate transactions, and the export turnover is almost nil. Even with the production reduced far below normal, makers are finding great difficulty in securing outlets, and it is extremely likely that the small number of furnaces in blast will be still further reduced. The tone is weak and prices are expected to fall still further.

Finished Steel and Iron.

Latest reports from the steel and ironworks are most disappointing, and there seems small ground for hopes of an early improvement in trade. Continental offers are as numerous as ever, but consumers being evidently as well covered as is necessary, are taking little advantage of the cheaper prices quoted. Steel makers have reduced their prices by 10s. per ton, the new figures being as follows :—Boiler plates, £13 per ton; ship plates, ¾in. and up, £9 15s. per ton; and angles, 7 united inches and up, £9 10s. per ton, all delivered Glasgow. Export prices are purely a matter of arrangement. Sheet makers are very busy, chiefly on export account, and thereby provide the one bright spot in the steel industry. Galvanised corrugated sheets are moving off with regularity to India, South Africa, and South America. Bar iron makers are poorly placed in respect to fresh orders, and the re-rolled steel department of this industry is in a similar position. Foreign competition is exceptionally keen.

Coal.

There has been no material alteration in the coal trade. Inquiries from some directions have been more prolific, but small hopes are entertained that business will follow at the prices quoted. German competition is held responsible for the dearth of export orders, and there appears little chance of an early alteration of conditions in this respect when it is stated that great efforts are to be made to increase outputs from the Ruhr. Any foreign business passing is meagre in quantity and for prompt shipment. It is said that many holders are taking up their colliery commitments at considerable loss, calculated to amount to between 6s. and 7s. per ton. Prices continue to decline, and all descriptions of fuel are easier with the exception of Lanarkshire ell, Fifeshire screened navigation and third-class steams, treble and double nuts. Single nuts, pearls, and drosses are especially weak. Aggregate shipments amounted to 284,340 tons, against 251,929 in the preceding week and 340,763 tons in the same week last year. Home industrial demands show no expansion, but household and municipal requirements are increasing as the season advances.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

There is singularly little of a fresh nature to record so far as the steam coal trade is concerned. Values have undergone no alteration and the position of the collieries generally remains very much about the same as it was a week ago. The supply of ready tonnage is below what is required to give real strength to the market or to absorb standing supplies of coal, with the result that most collieries have some difficulty in maintaining even recent figures, except possibly for the very best Admiralty large and dry coals. The scarcity of anthracite coals has stimulated the demand for dry qualities as a substitute, especially as regards sized descriptions, such as nuts. Few fresh inquiries of any magnitude have come along, although in some directions the demand has improved a shade. This is the case with superior bunker coals, which are a trifle better, but it is scarcely appreciable. So far there has been no buying over next year. Usually by this time foreign consumers and local contractors have approached the collieries in earnest with regard to supplies over the following twelve or six months, but so far as is known little or nothing has been done this autumn. One inquiry which has come to hand is from the Midi (French) Railways for 150,000 tons of large and through coals over 1925. Tenders have to be in this week and the coals are principally Monmouthshire descriptions. It will be interesting to see on what basis prices go in, as affording some idea as to what exporters' views are respecting business over next year.

Coalfield Items.

On the whole there has been practically no change respecting work in the coalfield. The latest report is that there are 39,000 men idle as the result of collieries suspending operations either permanently or temporarily. In some instances notices to terminate contracts have been withdrawn and the men are continuing at work on day-to-day contracts, while in other directions men have received notices to atop work. This is the case with several collieries in the Western Valleys of Monmouthshire, and the position is so serious that some of the miners appear to be disposed to advocate strong action on the lines of "all in or all out." As a matter of fact, the Executive Council of the South Wales Miners' Federation discussed the situation at the end of last week, and it was decided that its representatives on the Miners' Federation of Great Britain should request that body to convene a national conference for the purpose of considering the whole position of unemployment in the various coalfields. In the case of the Main Collieries at Skewen, which have been idle for about fourteen weeks, the directors have now decided to close the four pits until economic conditions improve, so that about 1100 men will continue to be on the unemployed list. Some idea as to the way in which colliery companies are affected by the depressing conditions of the past year is shown by the report of the International Coal Company. This report covers a period of twelve months to the end of June last, and the trading shows a loss of £11,495. The conditions have been worse since June than they were previously, so that collieries must be doing badly on the whole.

Miners' Wages.

Reference was made last week to the fact that the wage rate of the miners in this district would continue to be on the minimum for the current month, viz., 42.22 per cent., and in order to pay the difference between this and the actual percentage certified, which was only 16.08 per cent., the whole of the surplus and the owners' standard profits would be absorbed and still leave a monetary loss for the industry of over 1s. 3d. per ton on an output of 3,531,916 tons. In the course of a statement on the matter Mr. Finlay Gibson, the secretary of the South Wales Coalowners' Association, points out that there are several factors which explain the heavy deficiency in August, which is the period on which the audit is based. Production was phenomenally low, being affected by the holidays, and this resulted in increased costs of production, while there was a great decrease in the volume of the coal export trade. He states that trade has gone from bad to worse since the new agreement came into force. Up to the end of April the industry worked at a fair profit, but in May the average profit was only 2½d. per ton, whereas in the other three months the industry has been worked at a dead loss. In June the loss was 1s. 4.90d. per ton; in July .01d. per ton, and in August it was 1s. 3.63d. per ton. The total output in the last three months has been 11,354,668 tons, but on that total quantity there has been an aggregate loss of £471,291, which is equivalent to an average of 9.96d. per ton.

Fitters' Dispute.

Efforts to settle the dry docks dispute concerning the fitters have been resumed. The Executive Council of the Amalgamated Engineering Union in London has this week sent some of its members to this district to confer with the local district committees.

Current Business.

Business continues to be very difficult, as the foreign inquiry is scarcely more than a shadow of normal conditions, and buyers naturally persist in their efforts to buy at lower figures than they have had to pay even recently. The demand from Italy, which is usually fairly substantial, is much curtailed, while there is no material alteration in other directions. Best Admiralty large coals continue round about 27s. to 27s. 6d., and second grades vary from about 24s. 6d. to 26s. 6d. Dry coals are very steady on the basis of 27s. to 28s. for the superior grades, while dry nuts range up to as much as 32s. 6d., whereas bituminous qualities are scarcely worth more than 21s. 6d. to 24s. 6d. Small coals display no change, except that some of the bunkering qualities are rather steadier. There is no improvement in patent fuel or coke, while pitwood is quieter and easier on account of the falling off in the demand, as work at the pits is not so regular.

Faraday House Old Students' Association.—We are asked to state that the sixteenth annual dinner of the Faraday House Old Students' Association will be held at the Hotel Cecil on Friday, October 31st, when Mr. R. N. Vyvyan, M.I.E.E., will be in the chair. Members of the Association may introduce guests, who need not necessarily be Faradians. A musical entertainment will, as usual, follow the dinner. Early application for tickets should be made to the hon. secretary, H. W. Fairman, Faraday House, Southampton-row, London, W.C. 1.

Apprentice Scholarships.—The first holder of the "D. B. Morison" engineering scholarship, established in connection with Richardsons, Westgarth and Co., Limited, is Mr. Reginald Porter, of 45, Wansbeck-gardens, West Hartlepool. As the title of the scholarship indicates, it was founded by Mr. D. B. Morison with the approval of the directors of Richardsons, Westgarth and Co., Limited. Towards the fund, which guarantees £150 a year, Mr. Morison himself contributed £1000. The scholarship forms, as it were, the coping stone to the apprentice advancement scheme that was inaugurated by Mr. Morison at the Hartlepool Engine Works as long as twenty-two years ago. Through it the apprentice who has taken fullest advantage of this scheme, and who is successful in a special competitive examination, will be enabled to spend his fifth year at Armstrong College, Newcastle.

The Ferrantians.—In November, 1912, there was held in London a reunion of old Ferrantians, that is, those civil, mechanical and electrical engineers who were associated with the pioneer work of Dr. S. Z. de Ferranti. It was hoped at that time that these engineers would meet every year, but the war intervened and nothing has since been done. It is now felt that there should be another reunion, and it is hoped to hold it early in December, 1924, at the Hotel Cecil, in the form of a dinner at which it is expected Mr. C. H. Wordingham, C.B.E., will preside. Those of our readers who can lay claim to the title of old Ferrantians and who were connected with the famous engineer previous to 1905, are requested to communicate with the hon. secretary, Mr. W. E. Warrilow, 40, Mildred-avenue, Watford. Old Ferranti men overseas who may be in London at this particular time are cordially invited.

Engineering Golfing Society.—The autumn meeting of the Engineering Golfing Society was held on the course of the St. George's Hill Golf Club, Weybridge, on Wednesday, the 15th inst., forty-three competitors taking part in it. In the morning, as the result of the 18-hole medal round, the "Hele-Shaw" Scratch Challenge Cup and memento were won by C. H. Hayward, with a score of 76, the first handicap prize in the first division being won by E. C. MacKellar, with a score of 84—3 = 81, and the second prize by G. Allom, with 87—3 = 84. The first handicap prize in the second division was won by H. L. Williams with 94—13 = 81, the second prize being taken by J. J. Guest with 97—13 = 84. The prize for the best first 9 holes was won by S. R. Lowcock with 48—8½ = 39½, and for the second 9 nine holes by L. Trewby with 44—6½ = 37½. In the foursomes round against Bogey in the afternoon the "Hadfield" Challenge Cup and mementoes went to Messrs. G. Allom and C. H. Russell, 4 down, the second prizes being taken by C. H. Myddleton and E. W. Timmis with 5 down.

"Mavor and Coulson" Travelling Post-graduate Scholarship.—The Council of the Institution of Mining Engineers has accepted a generous offer, made by Mavor and Coulson, Limited, of Glasgow, of a sum of £250 for one year, for a post-graduate travelling scholarship, and of an additional sum of £50 in the case of America being included in the itinerary of the selected candidate. It is understood that it is the intention of Messrs. Mavor and Coulson to offer annually a similar sum for the same purpose. The award will be made by the Council of the Institution on the recommendation of a committee of selection, and will be regulated by the following conditions, among others :—(1) Value, £250 for one year. (2) Open to British subjects over twenty-one years and under twenty-six years of age who are student-members of the Institution of Mining Engineers, and who have graduated in mining at a university or college, or taken the associateship of the Royal School of Mines, and have had at least twelve months' underground experience in a colliery. (3) Candidates will be required to submit a thesis on a subject of their own choice connected with underground operations in coal mining. The thesis must be accompanied by a declaration that it is the sole work of the candidate. Credit will be given to a candidate for knowledge of a modern foreign language and also for evidence of facility in freehand sketching. (4) After consideration of the records of training and achievement submitted by candidates and of the report of the examiners of the thesis, the award will be made by the Council of the Institution of Mining Engineers, the decision of which will be final. The Council may withhold the scholarship if, in its opinion, no candidate with suitable qualifications presents himself. Further particulars may be obtained from the secretary of the Institution of Mining Engineers, Cleveland House, 225, City-road, London, E.C. 1.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	17/6 to 24/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 15 0	—
No. 1 Foundry	4 15 0	—
No. 3 Foundry	4 10 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 7 0	4 7 0
No. 1	4 7 6	4 7 6
Cleveland—		
No. 1	4 5 0	4 5 0
Silicious Iron	4 5 0	4 5 0
No. 3 G.M.B.	4 0 0	4 0 0
No. 4 Foundry	3 19 0	3 19 0
No. 4 Forge	3 18 0	3 18 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 16 0	—
„ „ Foundry	4 3 0	—
(3) Northampton—		
Foundry No. 3	3 16 0	—
„ Forge	3 9 0 to 3 10 0	
(3) Derbyshire—		
No. 3 Foundry	4 1 6 to 4 2 6	
Forge	3 15 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 10 0 to 4 12 0	
No. 4 Forge	4 12 6 to 4 15 0	
Basic	4 5 0 to 4 10 0	
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 5 0 (a)	—
	5 10 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 10 0	—
Best „	—	—
N.E Coast—		
Common Bars	12 10 0	—
Lancs —		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	13 10 0	—
Best „	14 0 0	—
Hoops	15 0 0	—
Midlands—		
Crown Bars	12 15 0 to 13 0 0	
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	—
Gas Tube Strip	13 0 0 to 13 5 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates, ½in. and up	9 15 0	—
Sections	9 10 0	—
Steel Sheets, 3/16in. to ½in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	9 15 0	—
Angles	9 10 0	—
Boiler Plates	13 0 0	—
Joists	9 10 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	9 10 0	—
Soft Billets	8 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 5 0†	—
Light „	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
Manchester—		
Bars (Round)	10 5 0 to 10 15 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
„ (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	9 10 0	
Intermediate Basic	9 0 0	
Soft Basic	8 0 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
Midlands—		
Small Rolled Bars	9 5 0 to 10 0 0	
Billets and Sheet-bars	7 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 0 0 to 18 5 0	
Angles	9 5 0 to 10 0 0	
Joists	9 5 0 to 10 0 0	
Tees	10 5 0 to 11 0 0	
Bridge and Tank Plates	10 10 0	—
Boiler Plates	14 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/6 to 23/7½
Block Tin (cash)	£15 5 0
„ (three months)	£17 12 6
Copper (cash)	£2 10 0
„ (three months)	£3 10 0
Spanish Lead (cash)	£5 0 0
„ (three months)	£4 0 0
Spelter (cash)	£3 7 6
„ (three months)	£3 3 9
Manchester—	
Copper, Best Selected Ingots	£7 10 0
„ Electrolytic	£8 10 0
„ Strong Sheets	£2 0 0
„ Tubes (Basis price)	0 1 1
Brass Tubes (Basis price)	0 0 11½
„ Condenser	0 1 2
Lead, English	£7 10 0
„ Foreign	£6 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	8/-
„ 6 p.c. to 8 p.c. „	£23 10 0	7/9
„ 8 p.c. to 10 p.c. „	£23 0 0	7/6
„ Specially Refined		
„ Max. 2 p.c. carbon	£43 0 0	16/-
„ „ 1 p.c. „	£52 0 0	17/6
„ „ 0.75 p.c. carbon	£60 0 0	20/-
„ „ carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0	scale 5/- per unit
„ „ 75 p.c.	£17 17 6	scale 6/- per unit
„ Vanadium	18/3 per lb.	
„ Molybdenum	7/9 per lb.	
„ Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£155	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	17/6
„ „ Ell	19/3
„ „ Splint	21/3 to 24/-
„ „ Trebles	21/3
„ „ Doubles	18/6
„ „ Singles	14/-
Ayrshire—	
(f.o.b. Ports)—Steam	17/6
„ „ Splint	21/3
„ „ Trebles	21/3
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	16/- to 17/6
Screened Navigation	28/-
Trebles	23/-
Doubles	18/9
Singles	14/6
Lothians—	
(f.o.b. Leith)—Best Steam	17/3
Secondary Steam	16/3
Trebles	21/9
Doubles	19/3
Singles	13/9

ENGLAND.

(8) N.W. Coast—	
Steams	28/6
Household	45/- to 55/6
Coke	32/6
Northumberland—	
Best Steams	17/9 to 18/-
Second Steams	17/6 to 18/-
Steam Smalls	10/9 to 11/-
Unscreened	15/6 to 17/-
Household	23/6 to 25/-
Durham—	
Best Gas	21/- to 21/6
Second	17/6 to 18/3
Household	23/6 to 25/-
Foundry Coke	25/6
Sheffield—	Inland.
Best Hand-packed Branch	32/- to 35/- —
Barnsley Best Silkstone	26/- to 28/- —
Derbyshire Best Brights	26/- to 28/- —
„ „ House	23/- to 25/- —
„ „ Large Nuts	21/- to 25/- —
„ „ Small „	13/- to 15/6 —
Yorkshire Hards	20/6 to 22/- —
Derbyshire „	20/- to 21/6 —
Rough Slacks	12/6 to 15/6 —
Nutty „	12/- to 14/- —
Smalls	6/- to 8/6 —
Blast-furnace Coke (Inland)*	— —
„ „ (Export)	f.o.b. 25/- to 25/6

Cardiff— (9) SOUTH WALES.	
Steam Coals:	
Best Smokeless Large	27/- to 27/6
Second „ „	25/6 to 26/6
Best Dry Large	27/6 to 28/-
Ordinary Dry Large	24/- to 26/-
Best Black Vein Large	24/6 to 25/-
Western Valley „	24/- to 24/6
Best Eastern Valley Large	24/- to 24/6
Ordinary „ „	23/- to 24/-
Best Steam Smalls	14/- to 15/6
Ordinary „	13/- to 14/-
Washed Nuts	25/- to 32/6
No. 3 Rhondda Large	27/- to 27/6
„ „ Smalls	19/ to 20/-
No. 2 „ Large	22/6 to 24/-
„ „ Through	18/- to 20/-
„ „ Smalls	11/- to 12/-
Foundry Coke (export)	45/- to 52/6
Furnace Coke (export)	30/- to 35/-
Patent Fuel	25/6 to 28/-
Pitwood (ex ship)	26/6 to 27/-
Swansea—	
Anthracite Coals	
Best Big Vein Large	52/6 to 55/-
Seconds	45/- to 47/6
Red Vein	35/- to 36/-
Machine-made Cobbles	60/- to 62/6
Nuts	55/- to 62/6
Beans	40/- to 45/-
Peas	24/- to 26/-
Breaker Duff	10/9 to 11/-
Rubbly Culm	12/3 to 12/9
Steam Coals:	
Large	22/6 to 23/6
Seconds	22/- to 22/6
Smalls	14/- to 16/-
Cargo Through	17/- to 19/-

(1) Delivered (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast furnaces only, 16/9, with fluctuations according to analysis; open market, round about 22/6 to 25/- at ovens. † Latest quotations available. (a) Delivered Sheffield or Glasgow. Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

The Engineering Situation.

If the French engineering trades have been only partially affected by external causes and have generally found steady employment on account of the reconstruction and other work being carried out in the country, they are certainly now being influenced by the lack of confidence and feeling of distrust arising from the change that has taken place under the Socialist administration. The attitude of the Government towards industrial interests is not conducive to the country's industrial welfare. To the objections of manufacturers against the action of the Government in taking considerable quantities of railway material and manufactured goods from Germany on account of reparations, the Prime Minister has replied that the general interests of the country must take precedence over the interests of particular industries. Locomotive and wagon builders must, therefore, close down their works while Germany is supplying the railway companies with the greater part of the material they need. The only satisfactory feature is the activity being displayed in the carrying out of municipal works and port equipment schemes, and some good colonial contracts are to be given out shortly; but the volume of business is so far restricted that engineering firms are finding the situation less satisfactory than it has been for a long while past. Boilermakers continue to do well on account of the development that is taking place in electrical distribution all over the country.

Central African Railways.

The French Congo is in a situation which many declare to be critical. Through lack of suitable means of communication it is impossible to develop the extremely prolific resources of that vast territory, and the financial deficit is growing every year. At present the French can only employ the Belgian railway from Leopoldville to Matadi, on the Congo, and this line is so hopelessly incapable of dealing with the traffic that the Belgian Government has decided to relay about 200 kiloms. with a metre gauge line and to electrify the greater part of the railway. Even then the French will be placed at a disadvantage, and the Minister of Colonies has, therefore, revived a project to construct a railway from Brazzaville to Pointe-Noire on the coast, where some extensive harbour works are to be carried out. A good deal of work at each end of the line was done before the war, and the line has been laid for a distance of about 40 kiloms. from Pointe-Noire, but on account of the depreciation of the franc the amount required to construct the railway vastly exceeds the original estimate. Between 360 and 400 million francs are needed to complete the railway and equip the port in the course of from five to seven years. The Minister of Colonies is endeavouring to provide for this sum in the forthcoming budget, but it is very doubtful whether the Minister of Finance will be able to fall in with his views.

Power Alcohol.

The Government is extremely embarrassed over the difficulty it experiences in disposing of the power alcohol it is obliged to purchase, under the terms of the monopoly, from the producers of the spirit distilled from beet and grain. It was expected that the law requiring importers of petrol and other motor spirit to purchase a quantity of alcohol equal to 10 per cent. of the amount of liquid fuel imported and to prepare a "national fuel" with a mixture in that proportion would have ensured the absorption of the entire home production of power alcohol. The "national fuel," however, has proved a hopeless failure, and had the law been enforced it would have proved disastrous to the motor industry. As the stocks of alcohol are still accumulating and some outlet must be found for the additional quantities which the Government has undertaken to buy, it has instituted a commission composed of representatives of the Government and of producers and users to investigate the ways and means of stimulating the consumption of power alcohol. The difficulty that had not been foreseen was the impossibility of getting the price of power alcohol down to a level which would allow it to compete with other fuels.

Salving a Locomotive.

A little while ago a locomotive on the Paris, Lyons and Mediterranean Railway collided with a train and fell from a bridge into a small river near the village of Saint-Denis-en-Bugey. The locomotive has just been salved by means of a breakdown crane which, by repeatedly lifting the engine at each end a few inches to allow of sleepers being passed underneath, succeeded in raising it to a sufficient height to permit of its being replaced on the rails. Close upon 1500 sleepers were employed.

Reconstruction.

In a report he has just issued upon the work accomplished in the devastated departments during the past five years the Minister of the Liberated Regions states that at the beginning of the present year 20,872 works and factories had been rebuilt out of a total of 22,900. The number of houses damaged or destroyed was 741,933, and of these 605,989 have been reconstructed. Nearly 4½ million acres of land have been put under cultivation. Of roads 42,360 kiloms. have been relaid out of a total of 58,697 kiloms. Of the 6125 bridges, viaducts, &c., destroyed, 4800 have been rebuilt. The number of colliery pits damaged was 200, and 145 of them have been put into working order. The coal output would be nearly equal to the pre-war figure if it were not for the operation of the eight hours' working day, or rather the manner in which the scheme is applied. As for the industrial capacity of the liberated regions, it is much greater than it was before, despite the fact that a number of works have to be rebuilt; but as these are mainly small shops, many of which have probably been abandoned, the work of reconstruction may be said to be nearing completion.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

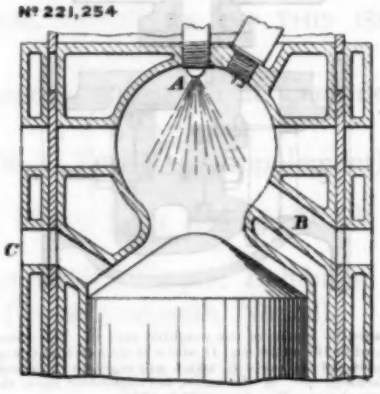
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

221,254. May 29th, 1923.—Compression Temperatures, A. E. L. Chorlton and W. Beardmore and Co., Limited, 36, Victoria-street, Westminster.

This invention relates to internal combustion engines working at compression pressures of about 150 lb. to 250 lb. per square inch, in which the fuel is injected directly into the combustion space of the working cylinder. Steps are usually taken whereby the temperature at the end of the compression stroke is raised above that due to the ratio of compression itself, such higher

No 221,254



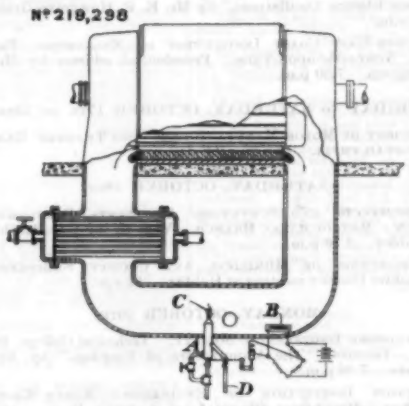
temperature being necessary to ensure the complete combustion of the fuel, and the inventors propose to supply the heat necessary to raise the temperature by the addition of a quick-burning agent, such as hydrogen, to the air of the charge. This combustible forms, with the air admitted to the engine cylinder, an ignitable but weak mixture, into which, when ignited by any well-known means, the liquid fuel can be directly injected at or about the point of ignition. In the illustration the oil fuel jet is shown at A, while the port for the admission of hydrogen is marked B. C is one of the air ports.—*August 29th*, 1924.

DYNAMOS AND MOTORS.

219,298. July 4th, 1924.—Improvements relating to Ventilating Systems for Dynamo-electric Machinery, *The Metropolitan-Vickers Electrical Company, of 4, Central Buildings, Westminster.*

In order to reduce the risk of fire in turbo-alternators, it is proposed to provide means for removing or fixing some or all of the free oxygen content of the air within the closed ventilating

No 219,298



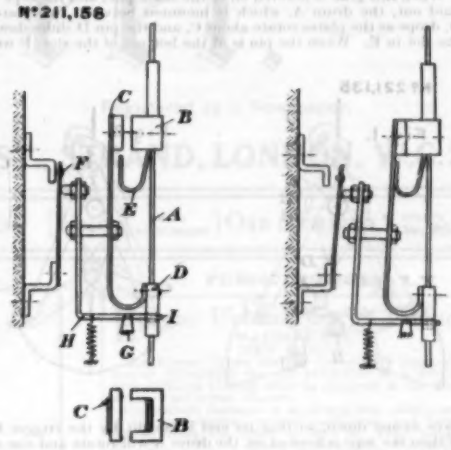
system. In the closed ventilating system a de-oxidising device A is provided. B is an oxygen-detecting element, which controls an electrical circuit. In turn this circuit controls a flame C. When the oxygen content falls below a predetermined value, the element B cools and causes valves to operate, so as to maintain a stable flame at C. Air for the flame is supplied through the pipe D.—*September 11th*, 1924.

SWITCHGEAR.

211,158. February 11th, 1924.—Hot Wire Relay, Voigt and Haeffner Aktiengesellschaft, of Hananerlandstrasse 152/158, Frankfort-on-Main, Germany.

When hot wires are used for releasing overload cut-outs, difficulty arises in connection with the design of a device which, when the current increases rapidly, will prevent the hot wire from melting. According to this invention, the hot wire is surrounded by a magnet, which, when the current attains a certain value, attracts an armature and puts a shunt across the hot wire. In the left-hand drawing A is the hot wire, B is the magnet, and C the armature, which is connected at D to the end connection of the hot wire, whilst E is the hot wire shunt. F is a contact device which is maintained in its closed position by the pressure of a spring-controlled lever H, pivoted at G. This lever extends beyond G and engages in a slot I in the end connection of the hot wire. As soon as the current exceeds a predetermined value, the wire A heats up, and if the increase in the overload is slow the hot wire extends, and by exerting a pressure on the lever H opens the contact F. If, however, a short circuit is suddenly produced or if there is a short circuit whilst the switch is being closed, before the current in the wire increases too much the magnet B becomes so strongly magnetised that it attracts its

No 211,158



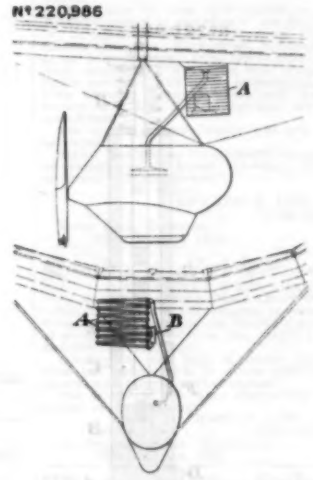
armature C, thereby closing the shunt E and relieving the wire of current, whilst at the same time the contact F is opened, as shown in the right-hand drawing.—*September 11th*, 1924.

AERONAUTICS.

220,986. May 25th, 1923.—Recovery of Water from Exhaust Gases, H. F. Parker, 29, Threadneedle-street, London, E.C. 2.

The inventor proposes to condense the water vapour in the engine exhaust gases for use in the ballast tanks of airships, and says that he finds the back pressure caused by the necessary condenser is not prohibitive, provided the tubes are 1in. in

No 220,986



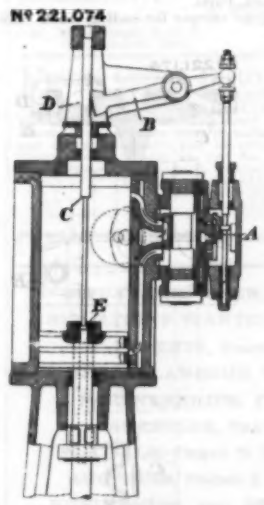
diameter by 60ft. long, for every 6 horse-power delivered by the engine. In the cut, A is a tubular condenser of aluminium, into which the exhaust is led at the top. The cooled exhaust is discharged through the chamber B, which is provided with baffles that separate out the water. It is suggested that fabric might be used in the construction of the condenser instead of metal.—*August 25th*, 1924.

PUMPING AND BLOWING MACHINERY.

221,074. August 21st, 1923.—Direct-acting Pumps, H. W. Pearn, 8, Leegate-road, Heaton Moor, Manchester.

In this pump the auxiliary slide valve A for operating the main steam distributing valve is worked by an overhead rocking

No 221,074

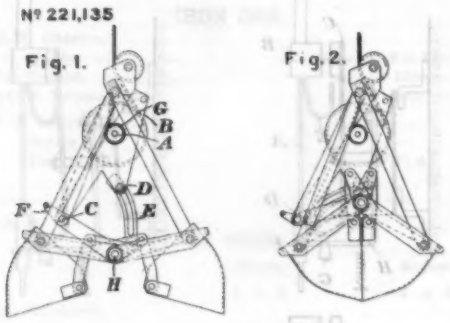


lever B. This lever is moved by the main piston through a tappet rod C and rack and quadrant D. The tappet rod is engaged near the end of each stroke by a plate E fixed to the piston, and is accommodated by a hole bored in the piston-rod.—*September 4th*, 1924.

CRANES AND CONVEYORS.

221,135. December 29th, 1923.—Single Rope Grabs, E. Kjode, Fjeldveien 79, Bergen, Norway.

When this grab is lowered on to the stock pile, and the rope is paid out, the drum A, which is mounted between two plates B, drops as the plates rotate about C, and the pin D slides down the slot in E. When the pin is at the bottom of the slot, E will

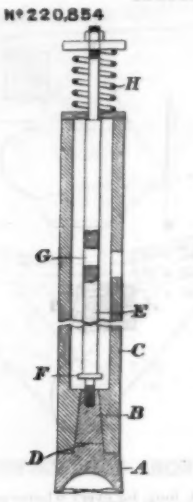


have swung down, so that its end is caught by the trigger F. If then the rope is hoisted on, the drum A will rotate and rise as the ropes G are wound up. Since the link E is held by the trigger, the pin D raises the main shaft H and the grab is brought to the closed position shown in Fig. 2. The load is discharged by pulling a line attached to the trigger F.—*September 4th*, 1924.

MACHINE TOOLS AND SHOP APPLIANCES.

220,854. November 7th, 1923.—Slotting Tools, Wm. Muir and Co., Limited, Sherbourne-street, Manchester, and J. H. Melloy.

The object of this invention is to provide within the body of the tool itself a relieving action for the cutting edge during the up stroke, and at the same time facilitate the removal of the cutter from its stock for grinding, for instance. The tool or cutter A has a conical shank or stem B which fits within a corresponding aperture at the lower end of the tool stock C. Lateral

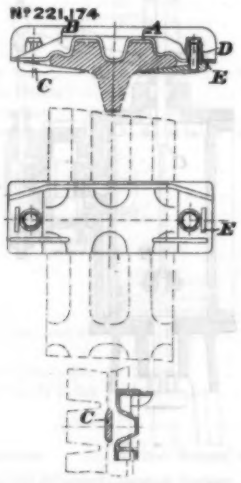


projections as D are formed on the stem B, and adapted to engage corresponding recesses in the stock to prevent relative rotation between cutter and stock. The bolt E, which is screwed into the upper end of the stem B, has a collar F to provide an abutment for limiting the relief on the up stroke. The bolt E has also a hole G for taking a tommy bar, so that the bolt may be pressed down against the action of the spring H. On thus pressing down the bolt the cutter can be readily unscrewed from the bolt E.—*August 28th*, 1924.

MOTOR CARS AND ROAD TRAFFIC.

221,174. July 8th, 1924.—Endless Tracks, A. Kegresse, 53, Rue Balard, Paris.

This gripper or creeper for endless track vehicles is made of

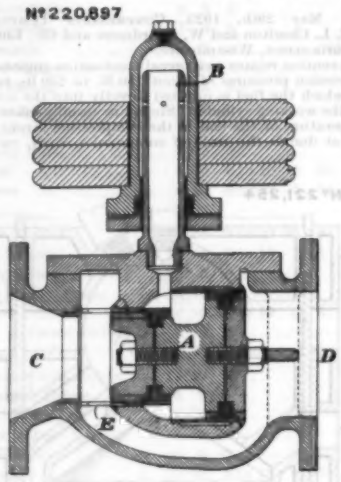


thin steel, and carries a base A, which fits exactly on the outer ribs of the tread of the endless track, while it protrudes on either side of the latter, and thus affords a strong base to the gripping ribs B in one piece with the base. The creeper is secured by two lugs C, which by means of pins and nuts D pinch or clamp the endless track between themselves and the base. These lugs are each bevelled on their outer face, so as to ensure continuous rotation of the rollers on the inner face of the endless track. Each of the lugs has its outer end terminated by a projection E, which fits into an opening provided for this purpose in the base A, so as to prevent the lug from rotating.—*September 4th*, 1924.

MISCELLANEOUS.

220,897. March 25th, 1924.—Reducing Valves, G. T. Edwards, 32, Westleigh-road, Leicester, and R. A. Blakeborough, Woodhouse Works, Brighouse.

In this reducing valve the usual spring-loaded diaphragm is replaced by a differential piston A, the opposing faces of which



are loaded by means of the weighted ram B. The steam inlet is at C, while the outlet is at D, and it is obvious that the opening and closing of the ports E, which will regulate the pressure on the discharge side of the valve, are dependent upon the load put upon the ram B.—*August 28th*, 1924.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

British Engineering Standards Association.—Institution of Mechanical Engineers, Storey's-gate, London, S.W. 1. Annual general meeting. 2.30 p.m.

Junior Institution of Engineers.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Lecture, "High-voltage Electric Oscillations," by Mr. R. P. Howgrave-Graham. 7.30 p.m.

North-East Coast Institution of Engineers.—Bolbec Hall, Newcastle-upon-Tyne. Presidential address by Mr. T. Westgarth. 7.30 p.m.

FRIDAY TO SATURDAY, OCTOBER 17TH TO 25TH.

Society of Motor Manufacturers' and Traders' Exhibition at Olympia. 10 a.m. each day.

SATURDAY, OCTOBER 18TH.

Architects' and Surveyors' Assistants' Professional Union: Metropolitan Branch.—Visit to the Gas Exhibit at Wembley. 2.30 p.m.

Institution of Municipal and County Engineers.—Yorkshire District meeting at Halifax. 11 a.m.

MONDAY, OCTOBER 20TH.

Bradford Engineering Society.—Technical College, Bradford.—Lecture, "The Manufacture of Forgings," by Mr. F. Somers. 7.30 p.m.

Junior Institution of Engineers: North-Western Section.—Manchester Geographical Society's Rooms, 16, St. Mary's Parsonage, Manchester. Informal discussion on "The Buying Department of an Engineering Works," opened by Mr. R. Harrison. 7.15 p.m.

Northampton Engineering College Engineering Society.—St. John-street, Clerkenwell, London, E.C. 1. Presidential address by Mr. S. C. Laws. A film on welding, entitled "The Power of Flame," by Captain Richardson. 5.30 p.m.

TUESDAY, OCTOBER 21ST.

Institution of Automobile Engineers: Coventry Centre.—Broadgate Café, Coventry. Presidential address "Research," by Dr. W. R. Ormandy. 7.15 p.m.

Institute of Marine Engineers.—85/88, The Minories, Tower Hill, London, E. 1. "Present Tendencies in Steam Generation," by Sir James Kemnal. 6.30 p.m.

WEDNESDAY, OCTOBER 22ND.

Faraday Society.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Joint discussion with the Geological and Mineralogical Societies on "The Physical Chemistry of Igneous Rock Formation." 3 to 7.30 p.m.

Institution of Automobile Engineers: North of England Centre.—Milton Hall, 244, Deansgate, Manchester. Presidential address, "Research," by Dr. W. R. Ormandy. 6.30 p.m.

Institution of Civil Engineers: Yorkshire Association.—Visit to the Gladstone System of Docks, under construction at Liverpool.

Institution of Engineering Inspection.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Crankless Engines," by Mr. A. Hamilton. 5 p.m.

Royal Microscopical Society.—20, Hanover-square, London, W. 1. "Super-saturated Solid Solutions," by Dr. R. H. Greaves; and "New Photo-micrographic Apparatus for all Purposes," by Mr. H. Wrighton. 7.30 p.m.

THURSDAY, OCTOBER 23RD.

Institution of Automobile Engineers: Luton Centre.—Training School of Vauxhall Motors, Limited, Luton. Graduates' meeting. Paper, "Positive Valve Control," by Mr. G. L. Ensor. 7 p.m.

Institution of Civil Engineers: Yorkshire Association.—The Griffin Hotel, Boar-lane, Leeds. Presidential address by Mr. G. A. Hart. 7.30 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Inaugural address by the President, Mr. W. B. Woodhouse. 6 p.m.

Institution of Welding Engineers.—The Engineers' Club, Coventry-street, London, W. 1. Informal dinner at 6.30 p.m. Paper, "Steel Wire: its Manufacture, Properties and Uses for Welding and other Purposes," by Mr. E. A. Atkins. 8 p.m.

Society of Chemical Industry: Chemical Engineering Group.—The Engineers' Club, 39, Coventry-street, London, W. 1. Papers: "Crystallisation," by Mr. Hugh Griffiths; and "The Development and Formation of Crystals," by Professor T. V. Barker. 5 p.m.

FRIDAY, OCTOBER 24TH.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "Powdered Fuel," by Mr. F. F. Evans. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's Gate, London, S.W. 1. "The Missing Pressure in Gas Engines; and Heat Loss in Gas Engines," by Professor W. T. David. 6 p.m.

SATURDAY, OCTOBER 25TH.

Institution of Automobile Engineers.—London graduates' visit to the Croydon Aerodrome, Waddon. 2.30 p.m.

Institution of Municipal and County Engineers.—Southern District meeting at Windsor. 11 a.m.

MONDAY, OCTOBER 27TH.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. Presidential address, "Research," by Dr. W. R. Ormandy. 7.30 p.m.

TUESDAY, OCTOBER 28TH.

Institution of Automobile Engineers.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Informal meeting at which recent inventions in connection with motor cars will be demonstrated and discussed. 7 p.m.

Institution of Engineers and Shipbuilders in Scotland. 39, Elmbank-crescent, Glasgow. Discussion on paper, "Pulverised Fuel in its Commercial Aspect," by Mr. A. J. T. Taylor. Paper, "A Proposed Form of Bow Construction," by Mr. E. F. Spanner. 7.30 p.m.

WEDNESDAY, OCTOBER 29TH.

University of London.—University College, Gower-street, London, W.C. 1. Lecture, "High Frequency Electric Measurements," I. "High Frequency Resistance," by Professor J. A. Fleming. 5 p.m.

THURSDAY, OCTOBER 30TH.

Institution of Automobile Engineers: Birmingham Centre.—Chamber of Commerce, New-street, Birmingham. Presidential address, "Research," by Dr. W. R. Ormandy. 6.45 p.m.

Institution of Locomotive Engineers.—The Engineers' Club, Coventry-street, London, W.1. Presidential address by Mr. J. E. Anderson. Lecture, "Solid Crank Axles for Locomotives," by Sir Henry Fowler. 7 p.m.

FRIDAY, OCTOBER 31ST.

Institute of Marine Engineers.—Hotel Cecil, Strand, London, W.C. 2. Annual Dinner. 6.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "Audio-frequency Transformers," by Mr. H. J. N. Riddle. 7.30 p.m.

TUESDAY TO THURSDAY, NOVEMBER 4TH TO 6TH.

Smoke Abatement League of Great Britain.—Town Hall, Manchester. Conference on Smoke Abatement.

TUESDAY TO SATURDAY, NOVEMBER 4TH TO 15TH.

Smoke Abatement Exhibition at the City Exhibition Hall Deansgate, Manchester.

CONTRACTS.

Ransome Machinery Company (1920), Limited, of 14–16, Grosvenor-gardens, London, S.W. 1, is supplying the concrete mixers for the Sydney harbour bridge contract of Dorman, Long and Co., Limited, and has also recently secured an order for twenty-seven steam-driven concrete mixers, complete with engines, for the Central Indian Coalfields, through the India Office.

The electric authorities of the city of Melbourne have placed an order with Alfred Herbert, Limited, Coventry, covering the supply of two Atritor self-contained pulveriser units for firing Babcock and Wilcox boilers, having a normal evaporation of 17,000 lb. per hour, and a heating surface of 4780 square feet. Low-velocity burners with means of regulation from the front of the furnace will be employed, and each Atritor will be driven direct by its own motor through a flexible coupling.

The London and North-Eastern Railway Company has placed a contract with Fullerton, Hodgart and Barclay, Limited, of Paisley, for four electrically driven three-throw hydraulic pumps, fitted with variable speed motors. Each pump will be capable of delivering 90 gallons per minute, against a pressure of 750 lb. per square inch. Two sets of these pumps are required for the company's power station at York, and the other two for the company's power station at Newcastle-on-Tyne.

J. Blakeborough and Sons, Limited, of Brighouse, Yorks., inform us that they have received an order to supply for the extensions of the Lake Coleridge (New Zealand) hydro-electric power scheme:—(*a*) Two Larner-Johnson valves, each 4ft. 6in. inlet diameter and 3ft. 6in. outlet diameter, to operate under a head of 536.5ft., for feeding turbines of 12,650 horse-power of the spiral casing Francis type; and (*b*) a complete set of head gates—seven in all and of various sizes—for tunnel, surge tanks, &c., each gate being provided with an automatic tripping device.